NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

EXPLORING OF WIRELESS TECHNOLOGY TO PROVIDE INFORMATION SHARING AMONG MILITARY, UNITED NATIONS AND CIVILIAN ORGANIZATIONS DURING COMPLEX HUMANITARIAN EMERGENCIES AND PEACEKEEPING OPERATIONS

by

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Natural as well as man-made disasters have become commonalities of daily life in recent decades for a large portion of the world's population. This growing trend reflects the worldwide proliferation in recent years of Complex Humanitarian Emergencies (CHEs) and peace operations. Humanitarian emergencies and peace operations are a complex mix of related activities that require the combined efforts of the UN, military, International Organizations (IOs) and Non-Governmental Organizations (NGOs). Given the nature and similarities of their missions, there is an ongoing need for these organizations to have access to accurate, current, and comprehensive information about field conditions and each other's movements. In several of the CHEs and peacekeeping operations of recent years, a recurring problem has been poor communication due to inadequate equipment, non-compatibility of equipment and a non-standardized communications infrastructure. This thesis explores the impact and possible benefits that wireless technology can provide to help bridge the communication gap that exists among the UN and the NGOs who participate in CHEs and peacekeeping operations.

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ABSTRACT

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Lieutenant Commander Douglas M. Bridges Jr.:

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Lieutenant Adonis R. Mason:

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I. INTRODUCTION

A. AREA OF RESEARCH

The purpose of this study is to explore wireless technology solutions and security mechanisms that would enable the safe and easy exchange of information and collaboration at the field level during Complex Humanitarian Emergencies (CHEs) and Peacekeeping Operations.

B. RESEARCH QUESTION

Given the security issues associated with wireless technology, can a commercial wireless communications system offer new and improve capabilities for the storing, distribution, retrieval, and the exchanging of information among the various organizations operating at the field level during CHEs and Peacekeeping Operations? If yes, what would be a recommended secure solution?

C. DISCUSSION

Everyday the media whether it be through infomercials, newspaper editorials, radio, or the Internet announces a major humanitarian plight or natural disaster somewhere in the world. Natural as well as man-made disasters have become commonalities of daily life in recent decades for a large portion of the world's population. Millions are exposed to famine, infectious diseases, hurricanes, and civil disturbances. Natural disasters when they strike cause massive destruction. For example, each year spontaneous calamities kill many people, cripple public services infrastructure, cause extensive economic losses, and subject the survivors to wide spread sustenance shortages and debilitating infectious diseases. Cyclone Marian, one of the most devastating natural disasters of recent times literally devastated Chittagong, Bangladesh in 1991. Marian's 140 miles-per-hour winds along with an eight meter tidal wave merciless pounded Chittagong, killing 139,000 people and one million livestock immediately and left over five million people homeless and exposed to famine and disease. [Ref 1]

Man-made catastrophes are just as severe. Hundreds of thousands of the earth's inhabitants continue to be subjected to the brutal atrocities perpetrated by governments, tribes, insurgents, or local police forces. In 1994, an estimated five to eight hundred thousand people were killed as a result of civil war and genocide in Rwanda, within a

period of three months. Large numbers were physically and psychologically afflicted for life through maiming, rape and other trauma. It is estimated that over two million fled to neighboring countries and maybe half as many became internally displaced within Rwanda. This is marked as being the greatest mass exodus witnessed in modern history. This human suffering was and is incomprehensible. [Ref 2] Prior to that, during a three-and- half- year war in Bosnia- Herzegovina which began in June 1991, over a quarter million people were killed or missing and more than two million, or half of the population were made homeless, most of whom were women and children. [Ref 3] In recent years, crises of these types have become more political in nature and usually entail violent conflict. Moreover, they typically are characterized by a breakdown of legitimate institutions and governance, widespread suffering and massive population displacements costing international donors a considerable amount of money and human resources to restore stability.

These recent missions have brought about a series of issues. One of particular concern is the lack of communication among the multinational actors involved in such missions. [Ref 4] In several of the CHEs and peacekeeping operations of recent years, a recurring problem has been poor communications due to a lack of effective integration of information resources. [Ref 5] When dealing with the concept of CHEs and peacekeeping operations, the United Nation (UN) and Non-Governmental Organizations (NGOs) acknowledge the importance of information sharing, however, they have not yet been able to fully achieve information exchange coherence. A main reason for this lack of unity is because the UN and NGOs have inadequate communications equipment, non-compatibility of equipment and lack of a standardized communications infrastructure. CHEs and peacekeeping operations are a complex mix of related activities that require the combined efforts of the UN, military, International Organizations (IOs) and NGOs and as a result, only through timely information sharing can they help bring about a quick end to these conflicts and prevent extreme human suffering. [Ref 6]

There are currently approximately 20,000 international NGOs that operate actively in more than three countries at once, an increase of 10,000 since 1995. Additionally, on an annual basis, NGOs provide much needed assistance to over 250 million people and contributes approximately $10 billion in aid more than the UN or any

single nation. However, because many of these organizations follow their own agenda, connectivity among themselves, the UN, and the military is ad hoc at best. [Ref 7] Given the nature and similarities of their missions, there is an ongoing need for these organizations to have access to accurate, current, and comprehensive information about field conditions and each other's movements. However, currently, there is no known information infrastructure in place that can be used to share information among the different agencies involved in these difficult missions. [Ref 8] As a result, some very public mishaps have occurred. During the operation in Somalia, senior officers from the United Nations Development Programme (UNDP) were arrested by United States (US) troops who were unaware that they were operating in the area in question. [Ref 9] Moreover, during the operation in Rwanda, the UN dropped leaflets to alert the millions of refugees to urge them to return home, yet the agency responsible for refugee matters, the United Nations High Commissioner for Refugees (UNHCR), had not been informed. [Ref 10]

In past as well as in recent missions, IOs, NGOs, the UN, and the military have been reluctant to share information, or act on information gathered by others. [Ref 11] Each agency operates homogeneously within its own chain of command focusing only on its position and responsibilities. Typically, each agency collects and analyzes information about the same environment and its inhabitants for planning purposes. However, lack of a central information mechanism prevents them from coordinating and sharing information among themselves with the frequency needed to solve problems. Furthermore, besides not having a common information sharing interface, part of the problem is the fact that these organizations have different principals: some of them, especially UN organisations, are answerable to various parts of the UN, some, especially state aid bodies, are answerable to the governments of individual states and some, especially NGOs, and certain IOs are answerable only to themselves. [Ref 12] This lack of coordination hampers relief efforts and creates distrust, duplication of effort, and frustration among all those involved. [Ref 13]

D. SCOPE OF THE THESIS

The authors will identify, analyze, and describe in sufficient detail several wireless technologies that could be used to provide the desired level of information

sharing among the various humanitarian agencies involved in CHEs and peacekeeping operations. Moreover, since security issues are at the forefront with wireless technology, the authors will give considerable attention to these concerns. We will explore the security risks as well as provide recommendations on how to mitigate them. It is our goal to develop a framework that will collectively satisfy the information needs of the respected organizations outlined in this study.

E. WHY WIRELESS?

Since the form of communication varies according to the type of mission and the environment in which these organizations operate, a wireless communication network would be the ideal tool to improve the exchanging of information among them. For example, when a natural disaster or civil conflict erupts, the people affected have a most pressing need for food, water, shelter, and security and these needs can only be served through a working communication system that can expediently tie all relief parties together. During natural or man-made disasters such as earthquakes, hurricanes, and civil wars, electricity and telephone service usually becomes inoperable. However the need for such services are never greater than during such calamities. All of the participating agencies involved in peacekeeping and CHE missions realize that the keys to saving lives include access to speedy and accurate information and sharing of information. However, the linkage of information available to the UN, the military, NGOs and IOs has been decidedly weak. [Ref 14] Hence, we feel that a viable solution to the UN's information woes would be wireless technology. Wireless signals are electromagnetic waves that can travel through the vacuum of outer space and through media, such as air in our atmosphere. Therefore, no cable medium is necessary. [Ref 15] This makes wireless a versatile means of building a network in remote environments, or in areas where the infrastructure has been badly damaged or destroyed.

The authors based their recommendation on the fact that most of these complex humanitarian operations take place in countries that do not have the infrastructure to provide adequate connectivity of service. These countries for the most part have serious problems with indigenous telecommunications and electric power. Thus, with these field constraints, we feel that the emphasis should be on a communication platform that can offer simplicity, mobility, speed, and off the shelf applications that can perform and

function in low-tech and chaotic field environments. Wireless technology can offer an instant communication infrastructure for locations that are geographically remote or have limited capacity for facilities. Therefore, Wireless technology is one of the better solutions to providing unlimited and universal access to basic communications and information service needs in such situations.

F. CHAPTER OUTLINE

Chapter II discusses the communication problems in CHEs and peacekeeping operations and the need for better information sharing among the international community. It also examines the communications equipment used by the UN and the other humanitarian agencies during CHEs and peacekeeping operations and discusses how various organizations are using Internet technology to combine, distribute, and exchange data among all cooperating systems, as well to help meet the needs of those exposed to human suffering. Chapter III examines specific wireless technologies and offers recommendations on which ones are most suitable to provide fast and continuous service in the field anywhere in the world. Chapter IV studies the security issues that are closely tied to wireless networks and make recommendations on which security measures are best to implement that would provide secure and reliable connectivity and transfer of information. Chapter V offers specific guidelines geared towards enhancing the UN's and the multitude of humanitarian agencies ability to exchange information, improve coordination and decision making during CHEs and peacekeeping operations.

G. BENEFITS OF THE STUDY

This thesis will demonstrate the viability of using a wireless communication network that can serve as a key information sharing mechanism at the field level among various agencies during CHEs and Peacekeeping Operations. Additionally, it will demonstrate the best security solution measures that can be used to protect the information flow over the network. The ultimate aim is a mutual exchange of information among all organizations outlined in this thesis, culminating in enhanced efficiency, productivity, and cost savings.

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II. COMMUNICATION PROBLEMS IN PEACEKEEPING OPERATIONS AND CHES

A. INTRODUCTION

The relationship among organizations is crucial to accomplishing any peace, security, or humanitarian mission. As stated in the Joint Task Force Commander's Handbook for Peace Operations, a Commander's main emphasis during any peacekeeping operations should be given to interagency coordination. [Ref 16] Successful mission accomplishments require the skills and resources many of the NGOs, IOs, and UN agencies have at their disposal. With their diverse cultures, talents, and abilities to respond quickly and effectively to crises, these respective agencies can help achieve economic and political stability and bring unity of effort to any mission. In essence, they can act as a force multiplier. [Ref 17]

UN multinational forces and civil operations undoubtedly affect each other at the strategic and tactical level, and without any overriding co-ordination there is a risk that they might counteract each other. For instance, at the strategic level, a decision about military intervention will have a large impact on the civil operation already in the area. Civil operations concerned with refugee return in turn may affect the status of the military operation. Successful civil operations of various kinds are a basic precondition for long-term stability and consequently also a precondition for the military operation to reach a successful conclusion. [Ref 18]

At the tactical level, civil-military partnership is necessary to provide on-site security, logistics requirements, and technical support to relief workers. For example, an NGO supplying provisions would need to know where supplies are needed most, the safest route to ensure shipment got through to those in need, and how to avoid conflict. Civilian entities and multinational forces thus need a fully operational information sharing mechanism that would allow them to safely exchange information about political, social, and humanitarian issues. Because people's lives are at risk during interventions, accurate and consistent delivery and dissemination of information is of the utmost importance and should not be left to chance. Information sharing between civilian and military agencies is the most curial link to establishing effective coordination and

decision-making during man-made or natural disaster response. Failure to establish good communication usually brings about confusion, mutual hostility, and creates serious dangers for all concerned, and certainly undermines the mission's viability. [Ref 19]

B. FIVE DOCUMENTED CASES OF COMMUNICATION FAILURES

Bosnia, Rwanda, Somalia, Operation Provide Comfort, and Operation Support Hope are five examples that illustrate many common problems with communication during peacekeeping operations and CHEs.

1. Bosnia

The UN's presence during the Bosnia conflict in 1992, that claimed the lives of about quarter million people and made more than two million homeless, is considered by most to be one of the UN's worse failures. [Ref 20] A critical look at the UN's involvement reveals that the 36,000 troops that made up the United Nations Protection Force (UNPROFOR) was unsuited for the conflict because they had no information or intelligence mechanisms in place to share information for their mutual benefits. Because UNPROFOR lacked an information gathering system, their commanders had no way to coordinate their activities. Time and time again, troops were sent out in the field without any detailed planning and asked to make decisions for which they were clearly ill prepared. [Ref 21] On reported occasions during the crisis, troops operating in one region that had access to information or advance warning of an offensive that was about to erupt, were not able to share data with their counterparts stationed in another region. The complete absence of a communications system resulted in a lack of coordination and cooperation, which ultimately led to more loss of lives and kept the conflict going long after it could have been brought to an end. [Ref 22]

2. Rwanda

The estimated one million people who lost their lives in 1994 as a result of the violence and massacres that occurred in Rwanda is linked to inadequate communications equipment and lack of coordination. [Ref 23] In the aftermath of the killings, a multi-national committee was formed to investigate why the UN was so slow to respond to the crisis even as the killings were broadcast on camera worldwide. The investigating commission concluded that long before the conflict started, the international community along with UN humanitarian agencies and other observers who were in Rwanda were

aware and concerned about the impending violence, but they were not able to coordinate their efforts because they did not have the proper communications systems in place.

The commission's report also stated that those within the UN who analysed the dynamics of CHEs did not have the mechanisms to coordinate or share their results with those who monitored human rights violations. There were no links between information collection and analysis. Moreover, the peacekeeping force station in the area ran an irregular intelligence operation and the human rights monitoring system, one of the most significant sources of early warning, was inaccessible to those in the field. It turned out that in the field, neither the UN nor any of the other agencies had comprehensive or structured capacity for information collection, sharing, and analysis. [Ref 24]

3. Somalia

Somalia ranks as one of the most dangerous operations the UN has ever undertaken. [Ref 25] The UN and the other relief agencies that entered Somalia in 1992 found a country with no functioning government, divided into factions controlled by warlords, and no formal communications infrastructure. [Ref 26] Exchanging information was so difficult that the heavily armed gangs who controlled the country were able to pillage relief supplies at will. [Ref 27] From the very beginning the UN knew that there were major problems on the ground. For example, some locations were inaccessible to aid because of the security risks posed by the locals. Despite these conditions, the UN failed to put in place appropriate mechanisms measures for protection and communication. [Ref 28]

The UN was clearly not ready for the complex responsibilities that existed with the Somalia conflict nor did the relief agencies tasked with providing aid to the millions that were suffering anticipate the need for good communication. Inadequate attention was given to the type of communications equipment needed as well as the location of agency operations. In the end, the UN's attempt to return a nation in chaos to a minimum standard of civility failed for a number of reasons and chiefly among them was the inability to establish a sound communication structure before undertaking a humanitarian mission in a hostile atmosphere. [Ref 29]

4. Operation Provide Comfort

After the Kurd's failed attempt to defeat the deflated Iraqi army, many of them fled to neighboring Iran and Turkey to avoid repercussions. The refugee situation quickly got out of hand as the Kurds desperately tried to escape from Sadam's pursuing army. Over one million Kurds found themselves in the freezing and mountainous regions of Turkey and Iran with no food, shelter, or water. The UN, recognizing that they did not have the resources to contain such a situation, solicited the help of its member states to assist the Kurds and to suppress Iraq's aggression. On 6 April 1991, Operation Provide Comfort was launched and multinational forces poured into Turkey and Northern Iraq to provide relief to the refugees and to protect them as they made their way back to Northern Iraq. [Ref 30]

The independently operating IOs, NGOs, PVOs and the multinational forces in theatre quickly recognized the need to coordinate their efforts. However, despite the fact that the multinational forces deployed with numerous pieces of communication equipment to support the relief efforts, communication among the various parties was non-existent. Few of the organizations had their own communication systems and those that did had to deal with inoperability issues due to non-standardized hardware. Some organizations had their own communication systems that consisted of single-channel HF radios and others made use of International Maritime satellite (INMARSAT) when available. However, none of these systems were interoperable. [Ref 31]

5. Operation Support Hope

Operation Support Hope is yet another situation where the UN and NGOs were simply overwhelmed and ill equipped to handle the crisis. In 1994 when the Rwandan Patriotic Front took over Kigali, Rwandan's capitol, many of the Hutus feeling trapped and fearful for their lives fled to Zaire and other Central African locations. It is estimated that within a 48-hour period, more than 1,283,000 people were in refugee camps. These camps, besides being over crowed, had no sanitation and very little provisions. As many as 3,000 people died a day from disease and starvation. Dubbed as being one of the worst humanitarian crisis of modern times, the UN and the international community (with the US being the largest contributor) deployed to Goma, Zaire, Kigali, Rwanda, and Entebbe,

Uganda, to help combat the outbreaks of cholera, bury the dead, and distribute the relief supplies. [Ref 32]

Not surprisingly, the UN in charge of the operation did not have adequate communications equipment to accommodate the military or the many NGOs and other relief agencies that were operating in the aforementioned areas. Surprisingly, however, most of the areas had a telephone infrastructure, which did function relatively well. This along with the many Civil-Military Operations Centers the military set up allowed the NGOs to stay in the field and transmit their requirements. [Ref 33]

C. ALL TOO COMMON PROBLEMS

All five cases demonstrate the basic problems of communication: inadequate communications equipment, non- compatibility of equipment and lack of a standardized communications infrastructure. They also clearly show the confusion that can occur whenever communication mechanisms are not in place. Inadequate communications equipment as well as non-compatibility issues cause agencies involved in CHEs and peacekeeping operations to spend more time working in isolation, which leads to goal conflicts and incompatible ends. Agencies may share the same goals during a CHE and peacekeeping operation, however, since they do not have a viable communication mechanism in which they could exchange information, they may disagree over the best way of achieving them. Thus poor communication hinders relief efforts and jeopardizes the safety of those involved in providing as well as those receiving aid. Conversely, a well formalized communication infrastructure that ensures interoperability makes it easier for every participating relief agency to become familiar with the goal or work model of every other organization involved in CHEs and peacekeeping operations. Responsibilities are likely to be clearer, differences over factual information to be reduced, and data as well as hardware and software to be better formatted to avoid information overload.

Geographical locations and the severity of the crisis also exacerbate communication problems in peacekeeping operations and CHEs. Most operations today take place in countries that do not have the infrastructure to provide adequate connectivity of service. Sometimes the problems are due to lack of resources, or in others, the conflict has rendered the infrastructure useless. For example, during the crisis

in Somalia no communication infrastructure existed. There was no telephone service because wires from electrical poles were all stripped bare. Buildings were blown apart and looted of everything of value. [Ref 34]

The wars that were fought in Central America during the 1970s and 1980s had some of the harshest terrains that humanitarian agencies had ever encountered. [Ref 35] Victims in need had fled to some of the most remote and rugged parts of Central America. It was almost impossible to reach them because of the limited transportation and communication infrastructure. [Ref 36] The terrain was inaccessible during the rainy and winter season and telephone and telegraph service were non-existent as well as inter-regional communications. [Ref 37]

Even in some areas that do have a skeletal infrastructure, the task of setting up or maintaining communications can be difficult especially when responding to a natural disaster such as an earthquake or hurricane. For example, the Gujarat earthquake of 2001, destroyed 95 percent of the houses, left 150,000 people without food or shelter, killed 14,976, injured 30,407, disrupted the power supply, disabled the telecommunication systems, and caused massive damage to roads and bridges. These conditions made it almost impossible for humanitarian personnel to provide aid. These crises situations are severe enough in and of themselves, but when they take place under conditions of war or civil unrest, they can overwhelm the resources of any organization. [Ref 38]

D. THE CHALLENGE

There is urgent need for the partners to fix their communication problems during CHEs and peacekeeping operations. Today's conflicts with all their complexities are likely to continue in the future and the UN and its partners are likely to be expected to address the needs of those who are unable to help themselves. Our world is not at peace. The realities faced by millions around the globe continue to be quite bleak. Armed conflicts, which are caused by a variety of reasons such as tyrannical dictators and inadequate governments, competition for natural resources, and ethnic hatreds, continue to burn throughout the planet. [Ref 39]

Thanks to mass communication, we now inhabit a world that has instant access to human suffering as it occurs. The situations that occurred in Rwanda and Bosnia-Herzegovina, where millions of innocent lives were lost and millions more were made homeless, are perfect examples of how the media can instantaneously remind us of the turbulence that exists in today's world. [Ref 40] In circumstances like these, the international community is likely to feel compelled to respond. Furthermore, since no one nation or organization can or is willing to act unilaterally in responding to the planet's strife, for the most part, future crisis will continue to be thrust upon the UN's, NGOs, military's, IO's, etc., agenda. [Ref 41]

Concurrently, the action orientation of the UN, NGOs and the many other humanitarian relief organizations is not likely to change significantly in the future. The challenge of the future for the UN and the multitude of the relief organizations will be to identify, define, and put in place a communications strategy that will enable them to work together so that they will be able to respond to future Somalias, Bosnias, and Rwandas without repeating the communications mistakes of the past. [Ref 42] It is important to remember that the surest way humanitarian agencies can achieve success during a CHE or peacekeeping operation is by trusting each other abilities, being clear and transparent in their dealings with one another, and keeping the lines of communications open. [Ref 43]

The prevailing lack of a well-designed information sharing system is perhaps the most important issue the these organizations need to address in the future, since it plays such a key role in establishing good coordination. [Ref 44] Lessons learned in the past have pointed to the need for the UN and the NGOs to take a more strategic approach to creating and managing a communications system that could inject greater rigor into interagency as well as interagency collaboration efforts. [Ref 45] Increased collaboration among humanitarian organizations is expected to minimize the overlap of activities and the duplication of efforts.

By acting together, all parties involved in peacekeeping or CHEs stand to make gains more quickly and effectively for the good of the global village or as Kahan stated:

> The entire military and civilian structure on the ground must be able to work together smoothly like partners on a dance floor. Multinational peace forces need similar and compatible equipment as well as compatible tactical methods of operation. Standardized communications at all levels is crucial to avoid mistakes or misunderstandings that can damage peace objectives or cause lives to be lost. [Ref 46]

E. CURRENT ATTEMPTS TO SOLVE THE COMMUNICATION PROBLEMS

The UN is obviously aware of their communications problems and is taking steps to resolve the issue. For example, the Office of the United Nations Security Coordinator (OUNSC) has recently developed a comprehensive security management training program that outlines the need to strengthen UN/NGO collaboration at the field level through the efficient use of common communications, joint security planning, information sharing and context analysis. [Ref 47] Moreover, individual agencies such as the World Health Organization (WHO) and World Food Program (WPF) organization have taken steps in that direction.

1. Stand Alone Initiatives

WHO is becoming more and more involved in rapid response both in complex emergencies as well as in the aftermath of natural disasters. Rapid response requires the deployment of several instruments, some of them for all conditions. In 2000 WHO's department of Emergency and Humanitarian Action (EHA) identified the need for an emergency kit that would be included along with health supplies communications equipment. IT would be geared towards providing standardized information to improve field-level data accuracy and consistency. The kit will consist of: a technical set, including a electric generator, solar energy equipment and adapter; a communication set including, a satellite phone, mobile phone, GPS, and hand-hold radios; and a data processing set, including a laptop, printer, and camera. EHA has not purchased the kits as yet because they want to ensure that they are congruent with what is used by the UN and NGOs partners. [Ref 48]

WFP installed and operates a countrywide communications network in Luna, Angola that supports the safe movement of aircraft transporting food, non-food items and passengers. Additionally, the communications network provides the infrastructure for running the corporate commodity tracking system, COMPAS (Commodity, Movement,

Processing and Analysis System) as well as ensuring availability of security telecommunications for staff working in highly unsecured places in the deep field. The WFP funded and supported network has thus evolved into the de-facto common UN/NGO communications system that supports 7 UN agencies and 80 NGOs for short distance operational and security communications. The network provides an uninterrupted information relay and emergency response capability for the field based WFP office, other UN agencies and NGOs. It also serves as a critical link in the UN security system, providing direct contact between the Luanda security unit, field posts and all points between. [Ref 49] WFP program is a step in the right direction. However, most humanitarian agencies instead of pursuing similar initiatives are mostly relying on the Internet as their technology of choice for sharing data among themselves.

2. Internet-Based Initiatives

The UN's problem is not the absence of information. Rather, it is the absence of a path for information to flow, a path that links all its information systems to the other information process of its partners. This process is important for rapid reaction, especially contingency planning. To address this issue, the UN and other humanitarian agencies have been turning to the Internet. The phenomenal growth of the Internet as an information resource and communication tool has led the UN to focus its attention on the need to establish a global information architecture to bring the Internet and other forms of electronic communications within reach of people throughout the globe. At an increasing rate, the UN and NGOs are linking into the Internet to reach and search specialized databases, potential donors and counterparts in other organizations who are in the business of peacekeeping and providing aid to nations in need. Almost all UN agencies and partnered organizations involved in the delivery of humanitarian relief now have their own site on the Internet, providing users around the world an opportunity to access their information.

In 1995 the Information Co-ordination Committee recommended that all UN organizations be connected to the Internet and in 1996, that they use the Internet as the primary technology for the access and dissemination of electronic information to external clients. [Ref 50] In today's environment, field workers as well as decision makers have more access to information than at any other time before. Governments, militaries, UN

and NGOs have improved connectivity through the widespread use of email and the World Wide Web. By setting up a public Website, many agencies involved in CHEs have been able to effectively share information and reach out to more donors. In addition to enhanced inter-agency as well as intra-agency communication, the wide spread use of Internet Websites have made it possible to gain access to immense amounts of previously unavailable information.

Today, most peacekeeping and humanitarian organizations are using the World Wide Web especially in the context of Websites as a tool to deliver better and faster humanitarian assistance to people around the globe. Provided below is a list of agencies that are harnessing the power of the Internet. A brief history as well as some of the remarkable features of these agencies' Websites is included.

a. United Nations High Commissioner for Refugees (UNHCR)

Established in 1950, UNHCR is the UN's leading agency for coordinating international efforts to safeguard and determine which actions are best to help solve the refugee problems throughout the world. With a staff of 5,000 they operate offices in over 120 countries assisting more than 20 million people with a mere annual budget of $ 1 billion. Under UNHCR's mandate, they are to provide humanitarian assistance to refugees who are specifically defined as people who flee their homeland and seek refuge in another country because of fear for their safety. However, in recent times, UNHCR has and is still currently assisting some 6.3 million so called internal displaced people (IDPs) throughout the world. IDPs are similar to refugees in that they also flee their homes as a result of civil conflicts, however, unlike refugees who flee to other nations, IDPs stay in their own countries. Furthermore, in the last decade with the development of a concept called quick impact projects, UNHCR has helped millions of returning refugees rebuild schools and clinics, repair roads, bridges and wells in Kosovo, East Timor, Africa's Great Lakes region, West Africa, the Balkans, Central America and other parts of the world. [Ref 51]

UNHCR's Web page is extremely well laid out. Its high quality design gives one easy access to voluminous amounts of information about past as well as the current situation of the world's refugees. From its pull down menu, one has at hers/his fingertips information about the history of UNHCR, the number of persons under their

mandate broken down by region, estimated number of refugees and total persons of concern worldwide, which goes back as far as 1980, current news on the status of refugees, donors and partners, publications on all different aspects of refugee issues, statistics outlining the latest numbers and graphics of the refugee plight worldwide, and maps to include satellite and aerial images of the countries of the world, etc. [Ref 52]

b. United Nations Department of Public Information/Non-Governmental Organization (DPI/NGO)

DPI was established in 1946 to, "actively assist and encourage national information services, educational institutions and other governmental and non-governmental organizations of all kinds interested in spreading information about the United Nations." For this and other purposes, it operates a fully equipped reference service, briefs, supplies lecturers, and makes available its publications, documentary films, film strips, posters and other exhibits for use by these agencies and organizations. [Ref 16] DPI/NGO Website offers access in seven different languages to over 1,600 NGOs located throughout the globe to current UN documents, press releases, DPI and UN system publications, a video lending library with a collection of UN system videos, monthly mailings of UN information materials to associated NGOs processes, UN passes for NGO representatives, etc. A noteworthy feature on DPI/NGO Website is their directory. Once you are in that section, one can use their pull down menus to get information on a host of NGOs activities: humanitarian affairs, conflict resolutions, environmental issues, political climate and family information by region and individual countries within the different regions. [Ref 53] The list is quite extensive and thorough.

c. United Nations Development Program (UNDP)

UNDP acts as the UN's global development network. Located in 166 countries, it assists developing nations meet the challenges of democratic governance, poverty reduction, crisis prevention and recovery, information and communications technology, and HIV/AIDS. UNDP's Website has an elaborate pull down menu that covers information on strategic partnerships, human development, current news and events, publications on a host of UN topics and links to over 100 Websites of their area of operations. [Ref 54] The site is impressive. UNDP is devoting significant attention and resources to IT-based knowledge management and has introduced a number of IT community-based ventures aimed at increasing knowledge sharing, accessibility, and

awareness to rural areas in Africa, the Arab states, Asia, Latin America and the Caribbean. Listed below are just a few of their IT enterprises.

(1) UNDP Africa IT Initiative (RWANDA). Netaid.org is a unique anti-poverty Website that was launched by the UNDP and Cisco Systems in 1999 to educate people around the world of the poor conditions that expectant mothers in the southeastern Kibungo district in Rwanda give birth. When one logs onto the Website, she/he has the option of purchasing one of a variety of birthing kits to be distributed to expectant mothers by the International Rescue Committee. The site also has a feature that gives donors the option to track the impact of their contribution. Netaid has done an effective job in educating visitors about the facts of life for Rwanda mothers and their babies. In a few short months after the site was launched, it quickly sold approximately 9,200 kits amounting to US $165,000 in donations. Since then features linking online professional volunteers from developed countries with people in less developed countries have been added. These new features are helping people from developed nations join in the fight against poverty by allowing easier connectivity and access to poor countries through the means of innovative partnerships. UNDP IT strategy by all measures has been a success. In 2000 netaid.org received $12 million in donations, and there have been more than fifty million hits, and some 8,000 individuals, 3,000 NGOs and 200 companies have joined the online venture in the fight against poverty. [Ref 55]

(2) Cameroon. An Internet Service Center named the Association for the Development of Women and Health (FESADE) has helped trained over one hundred women's groups as well as individuals throughout the towns and villages in Cameroon, in health and nutrition, dressmaking, farming, and livestock breeding. FESADE, which was initially affiliated with UNDP's Sustainable Development Network (SDNP) started its operation with three computers in Yaounde, a mostly rural city that had five telephone lines for every 1,000 people in 1996. Since then the program has done quite well. It now consists of 350 members, among them are scientists, NGOs, academics, and government officials, all of whom work together to identify the most appropriate IT measures that they could apply to meet their needs. [Ref 56]

Moreover, FESADE has more than one hundred people with mailing boxes located throughout five districts of Cameroon's ten provinces and it also provides service through its Internet help desk to more than 10,000 people who share information on a varieties of topics that are geared solely to helping improve the living standards of rural communities. In addition, FESADE also has added the Society for Initiatives in Rural Development and Environmental Protection (SIRDEP) Web page to its site. SIRDEP, which is located in the city of Bamenda, 450 kilometers away from Yaounde, is an indispensable organization for researching environmental, agricultural and livestock raising issues. [Ref 57] Furthermore, because SIRDEP's Website is directly connected to SDNP's servers, it provides instant worldwide access, which makes it an ideal forum for discussing global initiatives with the respected experts to improving the living standards of rural communities throughout the African continent.

(3) UNDP Arab States IT Initiative (EGYPT). In 1999 UNDP created three Technology Access Community Centers (TACCs) in Egypt's poor cities of Zagazig and Tenth of Ramadan, both located approximately eighty kilometers from Cairo. These centers were designed to introduce many of the poor citizens of Egypt who do not have access to computers because of income, education or location to the vast world of IT and to demonstrate its potential. Built in areas that have one telephone line per 100,000 people, these TACCs are similar to Internet Cafes in that they have Internet connections, fax lines, and printers. However, unlike Internet Cafes, which have a cost associated to them, these TACCs provide access free of charge to the public. [Ref 58]

Staffed by local as well as UN volunteers, these TACCs serve as hubs for electronic content creation, especially in Arabic, provides long distance education, telemedicine, e-commerce, and assistance to small businesses, environmental management, and women and youth empowerment to the community. These cyber centers have improved the lives of many in the community. For example, farmers can access Tacc.egnet.net Website and get information on better farming methods and mothers can access sound advice about how to prevent diarrhea and dehydration in infants. As a result of the success of these TACCs, Egypt's Ministry of Communications and Information Technology is developing 1,200 more cyber centers based on TACC's concept around the country. [Ref 59]

(4) UNDP Asia IT Initiative (MALAYSIA). Dubbed the Mobile Internet Unit (MIU), a huge silver bus staffed with UN volunteers goes around to rural schools throughout Malaysia promoting information and communications technology to those that lack the resources to learn computer training. UNDP, the Malaysian government and private sector partners sponsor this pilot program. It is managed through the Asia-Pacific Development (APDIP), which is a UNDP initiative that is based in Kuala Lumpur, the capitol city of Malaysia. In addition to the MIU initiative, APDIP since it creation in 1996 have assisted over forty-two countries in the region to use information and communications technology to promote social and economic development. [Ref 60]

The concept for the MIU was derived from a similar program used by UNDP in Africa to educate large numbers of people in rural areas about local problems such as famine and how to deal with HIV/AIDS. The MIU caters to students and teachers of all IT skill levels and provides ten one-hour lessons to help them acquire or harness their computer skills. What started out as a project strictly for the rural area schools has since spread to poor schools in the capitol city. A second phase of the MIU has already been worked out with the school system to donate one personal computer to every school that the silver bus visits, with free Internet access and server space to host Websites. Moreover, it is the government's intent that this program will help them achieve developed nation status by the year 2020. They have since made plans to replicate MIU and incorporated it into an e-learning project to expose its entire rural population of eleven million people to IT. [Ref 61]

(5) UNDP Latin America IT Initiative (PERU). In 1992, UNDP set up Programa Nacional de Informatica y Comunicaciones agency (PNIC) in Peru as a part of a larger program to bring IT to Latin America. What started as a one-person team has since blossomed into a staff of seventy IT professionals. PINC first project started with a US $400,000 grant from UNDP to build a website for the Oficina Registral de Lima y Callao (ORIC), which is an independent government and sole entity where one can verify the legal status of property, including businesses, lands, homes, and personal estates. Upon completion, the ORIC Web page became the first automated registry in Latin America. The Website instantaneously streamlined ORIC business

process turning it from management to service oriented. Prior to the Web page being installed, the process of registering or verifying the value of property, checking the status of a certificate or tracing the ownership of a plot of land was reduced from three to four weeks to a few click of a mouse in the convenience of one's home or office. [Ref 62]

In addition, PINC has also been responsible for developing and implementing computer networks and communication facilities for several of Peru's other government agencies, including the Ministry of Foreign Affairs, the National Institute for Consumer Defense, the Ministry for Women and Human Development and the Ministry of Justice. In a very short period of time, PINC's staff was able procure 600 computers along with the necessary hardware and software to transfer volumes of centuries old handwritten inscriptions onto more than 500 optical disks, established an elaborate fingerprint recognition system, and created user-friendly websites. [Ref 63]

Now that all these agencies are fully automated, it enables managers to become better connected with their organization, the environment, and each other. Moreover, these agencies have cut their processing time since putting their operation on computer networks, and just as important, the paperless system not only cut costs but improves customer service as well. PINC's next important project came in December 1999, when the team created an international NGO on information technology for development and a Website to reach out to new clienteles as well as a model for other Latin America countries to bench mark. [Ref 64]

(6) UNDP Caribbean IT Initiative (JAMAICA). As part of its global network for the disseminating information, UNDP in 1998 established a Sustainable Development Networking Program on the island of Jamaica to offer IT access to people in rural areas by setting up a number of Cyber Centers throughout the island. Since their inception, these centers have helped many of the island's residents get connected with friends and family abroad, provided distance learning courses to farmers, school teachers and students, as well as technical training to workers involved in the national plan to incorporate e-commerce initiatives to the island's business infrastructure. [Ref 65] These Cyber centers are proving to be an important component to Jamaica's IT strategy because they provide the ideal setting for the people to learn the information skills necessary to compete in the global market.

d. ReliefWeb

In 1994, the United Nations department of Humanitarian Affairs (UNDHA) received a request to create an international global network for communication and support from the international communication community. Two years later ReliefWeb was established to serve the needs of the international humanitarian community. Today, ReliefWeb is recognized globally as the premier online clearinghouse that disseminates the most current, reliable, and comprehensive information on unfolding CHEs. Even though it caters primarily to workers in the deep field, decision makers and the general public as well can learn much from its content. Guided by the principle that timely and reliable information on CHEs can help improve response time, maximize resources, and minimize the loss of human lives, the site currently hosts information provided by UN operational agencies, country governments, and innumerable NGOs. By combining and storing all this information into a central database, it encourages better transparency and accountability among the humanitarian relief participants and brings tangible results to their task. [Ref 66]

ReliefWeb is a veritable gold mine for workers in the field who need access to voluminous amount of information in a clear and systematic way. This especially holds true for field workers who are residing in areas with limited Internet access and slow connectivity. At present, there are three ReliefWeb offices located in Geneva, Switzerland, New York, New York, and Kobe, Japan that publish some 100 documents daily from over 700 hundred sources, relating to an average of 40 emergencies and disasters. ReliefWEB is easy to navigate and the browse options in its database is a particularly useful function for viewing financial contributions by country and reports (over 150,000 documents) by date, source, or format. It also has a by country menu which has integrated into it a broad range of current information and background documents relating to specific countries. Moreover, the site also hosts an extensive map center (over 1,500) featuring situation and political maps, disaster field manuals, an authoritative directory of disaster relief and humanitarian organizations, a detailed collection of materials on emergency telecommunications, and links to over 40 early warning Websites. [Ref 67]

e. International Committee of the Red Cross (ICRC)

The ICRC, which has permanent operations in sixty countries and conducts operations in over eighty, is considered one of the oldest disaster relief organizations in the world. Headquarted in Geneva, Switzerland, ICRC's primary focus is providing support and back up to its field employees who provides relief for a diverse array of disasters. The ICRC site provides easy access to unique information on its operations by country which features maps, data, reports, new releases, and miscellaneous publications on humanitarian operations with which the ICRC has been involved. ICRC's Web page also provide access to the international humanitarian law database which contains full text of ninety-one treaties and texts, commentaries on the Geneva Conventions and protocols, signatures, ratifications, and reservations. [Ref 68]

In order to increase its presence worldwide and specifically in Islamic countries, the ICRC in 1919 created the International Federation of Red Cross and Red Crescent Societies (IFRC). The IFRC is used in place of the ICRC in muslamic countries and today the IFRC has helped the ICRC achieve a presence in almost every country in the world. In addition to worldwide presence, IFRC's site contains a directory of addresses and contact information for National Red Cross and Red Crescent Societies in 178 countries, its own catalogue of publications as well as links to many countries society Websites. [Ref 69]

f. US Agency for International Development (USAID)/ Office of Foreign Disaster Assistance (OFDA)

Websites for these organizations deal exclusively with CHEs and contain valuable resources for those seeking information on disasters. USAID is the US principal vehicle for providing foreign assistance and humanitarian aid to countries recovering from disaster, trying to pull away from poverty, and engaging in democratic reforms. USAID, which is headquartered in Washington, D.C., works in close partnership with more than 3,500 American companies and over 300 US based private voluntary organizations as well as indigenous organizations, universities, IOs, and other governments worldwide. One of USAID's main objectives is to advance the political and economic growth of the US by responding to the needs of others during natural disasters.

In fiscal year 2002, USAID responded to 75 disasters in 60 countries, 50 were natural and 25 complex. [Ref 70]

USAID has made available thousands of pages of valuable information on its Website, much of which deals with its policies and operations. USAID's primary objectives are to assist people in long-term recovery after disasters by: rebuilding homes and communities, re-establishing democracy and governance, providing conflict mitigation and human rights programs, transition initiative, disaster assistance, food assistance, conducting varied and extensive educational efforts in Africa and Latin America in the areas of family planning, gender, global health, economic and related issues. [Ref 71]

Additionally, the USAID Website features many worthwhile sections that contain useful information on the four regions of the world where it provides assistance. For example, when one clicks on country and regional profile, one is provided in-depth information on the background of the particular country in question. It includes: USAID involvement and results review; human rights report; world facts book; congressional budget justification for USAID's involvement; links to government institutions; IOs; media; universities, and multilateral donors. Hosted also on USAID's site is the Global Education Database. It provides users with access to a wide variety of education variables such as school enrollments, gender parity, and public education expenditures for over 200 countries. [Ref 72]

OFDA, which is part of USAID, is the first to respond whenever disaster strikes a foreign country. OFDA has several useful resources on its site, including a field operational manual and mitigation handbook, which are bibles for field workers and situational reports. By clicking on the situational reports link, one can view fact sheets pertaining to several of the operations in which OFDA is currently involved. These fact sheets are very thorough and consist of such information as the total population of the country (from CIA fact sheet) the current political situation, number of IDPs, number of returning refugees, military and security situation, the type of activities OFDA and its partnering are involved in broken down by region and costs, and the total funds provided to the country broken down by fiscal years. [Ref 73]

g. InterAction

InterAction is made up of 160 NGOs involved in providing humanitarian and global disaster relief during CHEs. InterAction was created in 1984, and is headquartered in Washington, D.C. It has a staff of 35 and additional workers based in 25 states. It is both faith and secular based and it receives over $3 billion yearly from private donors to help foster economic and social development, provide relief to those affected by disaster and war, assist refugees and IDPs, and advocate human rights. Its Website provides links to all of its members' Websites listed in alphabetical order. As the leading advocate for international relief, refugees, and development programs, InterAction's website also contains links to disaster response training organizations, workshops and conferences, country situation and member reports, refugee facts and information, and information on development. Moreover, from its pull down menu, one can gain easy access to information pertaining to policy and legislative advocacy documents, global partnership campaigns, gender equality issues, as well as purchase publications online. [Ref 74]

h. International Telecommunications Union (ITU)

Headquartered in Geneva, Switzerland, ITU is an international organization within the UN hierarchy. It was founded in May 1865 as a result of the rapid expansion of telegraph networks in some countries. Its founding members were tasked with developing a framework for interconnectivity, rules for the standardizing equipment, instructions for international interconnection, and common international tariff and accounting rules. Today, ITU is still governed by the same underlying principles that created it. ITU is still the world's premier regulatory body for telecommunication technology and under its constitution, its members purposes are:

- To maintain and extend international cooperation between all its member states for the improvement and rational use of telecommunications of all kinds.
- To promote and enhance participation of entities and organizations in the activities of the Union, and to foster fruitful cooperation and partnership between them and Member States for the fulfillment of the overall objectives embodied in the purposes of the Union.
- To promote and offer technical assistance to developing countries in the field of telecommunications, and also to promote the mobilization of the

material, human and financial resources needed to improve access to telecommunications services in such countries.

- To promote the development of technical facilities and their most efficient operation, with a view to improving the efficiency of telecommunication services, increasing their usefulness and making them, so far as possible, generally available to the public.
- To promote the extension of the benefits of new telecommunication technologies to all the world's inhabitants.
- To promote the use of telecommunication services with the objective of facilitating peaceful relations.
- To harmonize the actions of member states and promote fruitful and constructive cooperation and partnership between Member States and Sector Members in the attainment of those ends.
- To promote, at the international level, the adoption of a broader approach to the issues of telecommunications in the global information economy and society, by cooperating with other world and regional intergovernmental organizations and those non-governmental organizations concerned with telecommunications. [Ref 75]

ITU in recent years has been one of the most active development organizations and donors within the information technology field. ITU has been proactive in helping developing countries tackle their information needs by extending the reach and frequency of their regions through such advanced technologies as Integrated Services Digital Network (ISDN), satellite broadcasting systems, digital and optical switching systems, ATM (Asynchronous Transfer Mode), cellular telephony, and most recently, global mobile personal satellite. Moreover, through its field operations and regional presence, ITU has been able to work closely with its members, NGOs, and other UN humanitarian and peacekeeping agencies to shape BDT activities to meet the needs of the world's developing countries. Its 11 field offices provide both technical and logistical support for BDT activities. In addition, its regional presence serves to:

- Represent, as and when required, the Secretary-General or one of the Directors of the Bureau of the three Sectors.
- Provide necessary support to the Directors of the Radio communication and Telecommunication Standardization Bureau for the organization, in the region concerned, of certain events.
- Act, as far as possible, as a link for the exchange and dissemination of information on the activities of the Radio communication and

Telecommunication Standardization Sectors in the mutual interests of the Union and the countries of the region.

- Cover the four basic functions of ITU-D identified in the strategic plan of the Union, namely: specialized agency, executing agency, resource mobilizer and information center. [Ref 76]

The ITU Website is one with considerable information available on key telecommunications issues. It makes available extensive information on its three sectors of the organization namely, radio communication, standardization, and development. In addition, it also lists: major conferences; ventures with other organizations; telcoms events; finance and staffing; field operations and regional presence; telecommunication indicators (statistics and analysis); list of ITU members; links to numerous other telecommunication entities and lots more. Its list of members section, which contains a global directory, is quite impressive and contains information on 189 member states, when they joined and their budget contributions. The same is true for its 650 sector members and its 60 sector associates. The database also houses information on ITU's council membership, its region and UN classification of countries, the world's major telecommunication operators, equipment manufactures, funding bodies, research and development organizations as well as international and regional telecommunication organizations. [Ref 77]

F. FRAMEWORK FOR THE FUTURE

The Internet has obviously revolutionized the way many NGOs and the UN conduct business. The sheer size of these agencies' networks and the number of individuals connected to them are unprecedented. Also, the quantity of data produced via these networks has qualitatively changed the nature of information exchange, in terms of availability and permanence. However, their capacity to use this new information-sharing tool effectively is still in its infancy.

The UN and NGOs have recognized the fact that effective flow of information on the Web should be delivered independently of organizational structure. This is called one-stop shopping or a portal. This approach is designed to allow one to access services or information in one convenient location without having to know which agency handles the service or information. Instead of having to search for information provided by

multiple agencies, one would simply find a list of agencies' Websites to click in a central area.

Unfortunately, most UN and NGO portals push the request for information to the individual agency and its technology systems for processing. Accessing information from these Websites is still a one-to-one relationship with the agency that offers it. This does not represent real process integration of UN and NGOs operations. Also, many of these agencies still do not possess the means for moving data that is contained on these Websites to and from the operational or tactical level. This situation occurs because organizational structures, incompatible equipment, and IT systems are not integrated. In addition, web designers have not quite yet figured out how to signal the availability of, and guide users to, the information posted on Websites because of the inherently decentralized nature of their Web pages. These Websites are an endless source of information, yet, tens of thousands of pages are posted in an ad hoc fashion, by numerous relief agencies, making it difficult to find or share the right information. Ultimately, what is needed, besides a common portal, are tools, common standards, and joint mechanisms for indexing, searching, retrieving and sharing information from all UN and NGO Websites. Ultimately, by piloting schemes for better use of Internet technologies, the UN and the many humanitarian agencies involved in CHEs and peacekeeping operations eventually can make more information available in an easy user-friendly format, create work flow linkages among themselves, and improve communication.

III. WIRELESS TECHNOLOGY

> Principal among our tasks is the need to develop and detail practical steps for facilitating the rapid deployment and effective use of communication equipment for emergency operations by reducing and, where possible, removing regulatory barriers and strengthening cooperation between states. [Ref 78]

A. OVERVIEW

Chapter II summarized the communication problems. This chapter discusses wireless technology as an alternative for information sharing among various agencies during CHE and peacekeeping operations in areas of the world were a viable wired infrastructure is not present.

B. INTRODUCTION

Wireless communications provides the user the freedom to work from almost anywhere while maintaining access to personal information. The world of wireless data includes fixed microwave links, wireless Local Area Networks (LANs), data over cellular networks, wireless Wide Area Networks (WANs), satellite links, digital dispatch networks, one-way and two-way paging networks, diffuse infrared, laser-based communications, keyless car entry, the Global Positioning System (GPS) and more. The benefits of wireless include connections when no others are possible, connections at lower cost in many scenarios, faster connections, backups to landlines, networks that are much faster to install and data connections for mobile users. Wireless as a solution is based on the information that will be communicated. Wireless communications provide value added results when data needs to be communicated in real-time and the users are mobile and do not have convenient access to wired connections. This chapter's focus will be on wide-area wireless data.

Investing in a robust wireless communications system would help the UN, NGOs, and military alleviate much of their communications problems. With such a system in place, the principle players would be in a much better position to coordinate, assist, and make access to various specialized information that could be distributed among various entities located in the field throughout the world in a timely manner. As pointed out earlier, the UN, NGOs, military are extremely efficient in producing volumes of reports

and publications, but are much poorer at disseminating them to those who need it most. The challenge then is how to make more of this information available to users on the front line, those who are directly involved in providing aid. When a disaster or civil conflict of a large magnitude develops, the UN and other humanitarian organizations are the first to send out teams to evaluate what is needed. In most cases, it is a challenge for these teams once deployed to receive or send information back to headquarters because of the damages caused to the electrical and telephone infrastructure of the country in question. A wireless infrastructure in such a situation would remove much of the barriers associated with accessing information from isolated areas that lose or do not have to begin with required wired facilities that would enable Internet connectivity.

Likewise, much information on disasters and peacekeeping are available on UN and other agencies Websites. Documents covering all aspects of an agency's expertise are frequently available, either to be read or downloaded. However, while the aid community has been focusing their efforts and attention on how to fully integrate and foster synergies and complementary actions at the headquarters level among UN systems and other stakeholders, very little attention has been paid on how to disseminate, exchange, and put best practices to use in field operations. With a sound wireless structure in place, such a relationship is quite possible.

Moreover, the crux of the UN's, NGOs' and military's inability to solving their communication problems lies in their lack of planning. With a well-organized wireless information platform, extracting information from different sources on the Web would be no more difficult than preparing for a face-to-face meeting. The real challenge is not the hardware nor the software; it is the format. What is needed is a well thought out plan that would deliver practical and useful information to those in the field and at the same time fit perfectly into the UN's, NGOs' and military's larger vision of electronic information networking, in other words, a usable wireless architecture.

C. WHAT IS WIRELESS

Wireless communications begin with a message that is converted into an electronic signal by a device called a transmitter. The transmitter uses an oscillator to generate radio waves. The transmitter modulates the radio wave to carry the electronic signal and then sends the modified radio signal out through space, where it is picked up

by a receiver. The receiver decodes, or demodulates, the radio wave in order to recover the original information that was sent. Wireless communications involve either one-way transmissions or two-way transmissions. A basic pager is an example of a radio receiver with one-way transmission. Two-way transmissions require both a transmitter and a receiver for sending and receiving signals. A device that functions as both a transmitter and a receiver is called a transceiver. [Ref 79]

D. WIRELESS NETWORK TYPES

Networks that cover a large geographical area are called wireless Wide-Area Networks (WANs). Networks that cover an office or building are called wireless Local-Area Networks (LANs).

1. Wireless WANs

Wide-area wireless systems possess the following characteristics: RF communications in commercial frequency bands, commercially owned and operated communications infrastructure, commercial standards, vendor proprietary protocols, and mobility of users and communications.

2. Wireless LANs

Local-area wireless systems differ from wide-area wireless systems in that the user owns the wireless infrastructure. The user purchases the components and does not rely on a service provider for wireless LAN operation. A wireless LAN is tied to a wired LAN environment in most cases. Wireless LANs operate in an unlicensed frequency band, and its use may be restricted in some countries. Local-area wireless technology does not offer the level of information sharing desired, therefore, it will not be covered in this thesis.

E. INTERNATIONAL MOBILE TELECOMMUNICATIONS – 2000

In 1999, ITU approved an industry standard for third-generation (3G) wireless networks. This standard, called International Mobile Telecommunications-2000 (IMT-2000), consists of five operating modes, including three based on Code Division Multiple Access (CDMA) technology. These 3G CDMA modes are most commonly known as CDMA2000, WCDMA and TD-SCDMA.

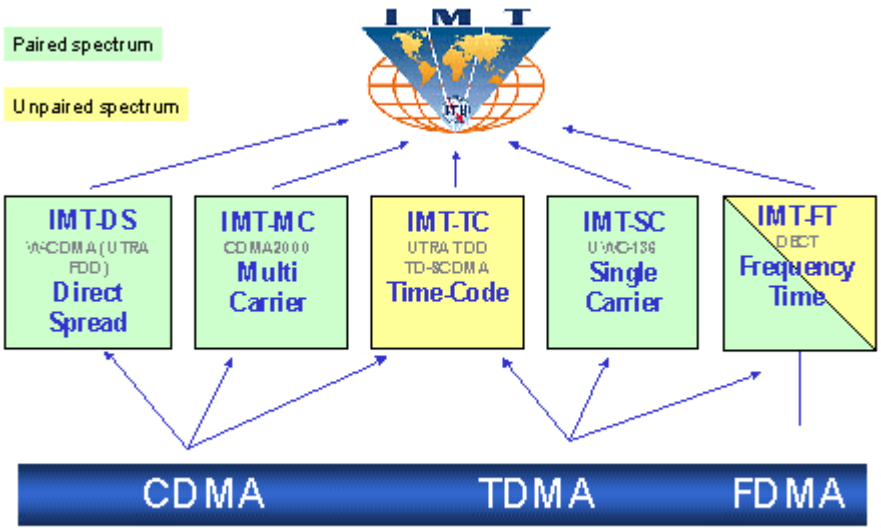

Figure 3.1 IMT-2000 Terrestrial Radio Interfaces [From Ref 80]

1. Access Technologies (CDMA, TDMA, FDMA)

Code Division Multiple Access (CDMA) is based on spread spectrum technology. Since it is suitable for encrypted transmissions, it has long been used for military purposes. CDMA increases spectrum capacity by allowing all users to occupy all channels at the same time. Transmissions are spread over the whole radio band, and each voice or data call are assigned a unique code to differentiate from the other calls carried over the same spectrum. CDMA allows for a soft hand-off, which means that terminals can communicate with several base stations at the same time. Terminals are a variety of mobile phones and mobile stations that can be used in the IMT-2000 environment. The dominant radio interface for IMT-2000 will be a wideband version of CDMA with three modes (IMT-DS, IMT-MC and IMT-TC). [Ref 81]

Time Division Multiple Access (TDMA) improves spectrum capacity by splitting each frequency into time slots. TDMA allows each user to access the entire radio frequency channel for the short period of a call. Other users share this same frequency channel at different time slots. The base station continually switches from user to user on the channel. TDMA is the dominant technology for the second generation mobile cellular networks. [Ref 82]

Frequency Division Multiple Access (FDMA) is the most common analog system. It is a technique whereby spectrum is divided up into frequencies and then

assigned to users. With FDMA, only one subscriber at any given time is assigned to a channel. The channel therefore is closed to other conversations until the initial call is finished, or until it is handed-off to a different channel. A full-duplex FDMA transmission requires two channels, one for transmitting and the other for receiving. FDMA has been used for first generation analog systems. [Ref 83]

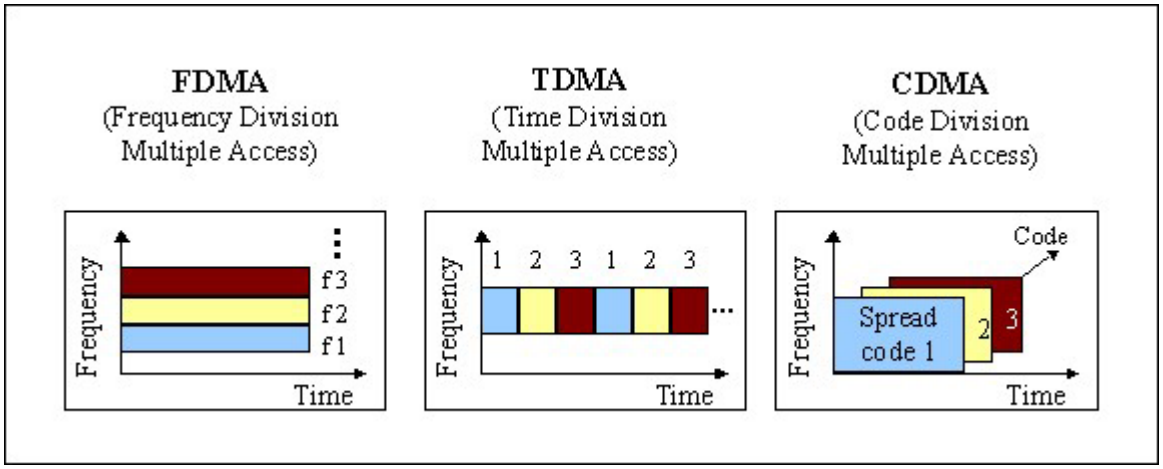

Figure 3.2 Access Technologies [From Ref 84]

2. IMT-2000 Benefits

IMT-2000 offers the capability of providing value-added services and applications on the basis of a single standard. The system provides a platform for distributing converged fixed, mobile, voice, data, Internet and multimedia services. One of its key visions is to provide seamless global roaming, enabling users to move across borders while using the same number and handset. IMT-2000 also aims to provide seamless delivery of services, over a number of media including satellite. It is expected that IMT-2000 will provide higher transmission rates with a minimum speed of 2Mbit/s for stationary or walking users, and 348 kbit/s in a moving vehicle. Second generation (2G) systems only provide transmission rates of 9.6 kbit/s to 28.8 kbit/s. [Ref 85]

Characteristics of IMT-2000 are as follows:

- IMT-2000 addresses the problem faced by operators having to support a wide range of different interfaces and technologies caused by mergers and consolidations occurring in the mobile industry, by providing a highly flexible system, capable of supporting a wide range of services and applications. The IMT-2000 standard accommodates five possible radio

interfaces based on three different access technologies (FDMA, TDMA and CDMA) as illustrated in Figure 3.1.

- Through the ITU umbrella, an agreement within the industry to make IMT-2000 affordable will stimulate adoption by consumers and operators.
- IMT-2000 services must be compatible with existing systems. 2G systems, such as the GSM standard (prevalent in Europe and parts of Asia and Africa) will continue to exist for some time and compatibility with these systems must be assured through effective and seamless migration paths.
- The IMT-2000 must be modular in design so that it is easily expandable in order to allow for growth in users, coverage areas, and new services, with minimum initial investment.

F. SATELLITE COMMUNICATIONS

A satellite is a specialized wireless receiver/transmitter or a radio-frequency repeater that is launched by a rocket and placed in orbit around the earth. Today, there are hundreds of commercial satellites in operation around the world. These satellites are used for such diverse purposes as wide-area network communication, weather forecasting, television broadcasting, amateur radio communications, Internet access and the Global Position System (GPS).

Satellite communications provide global signal coverage for transmission and reception without any dependence on infrastructure. This technology expands the benefit of mobility to less developed areas that lack phone lines and electricity. In contrast, cellular technology is dependent on infrastructure such as land based wireless transmitters that are limited in coverage.

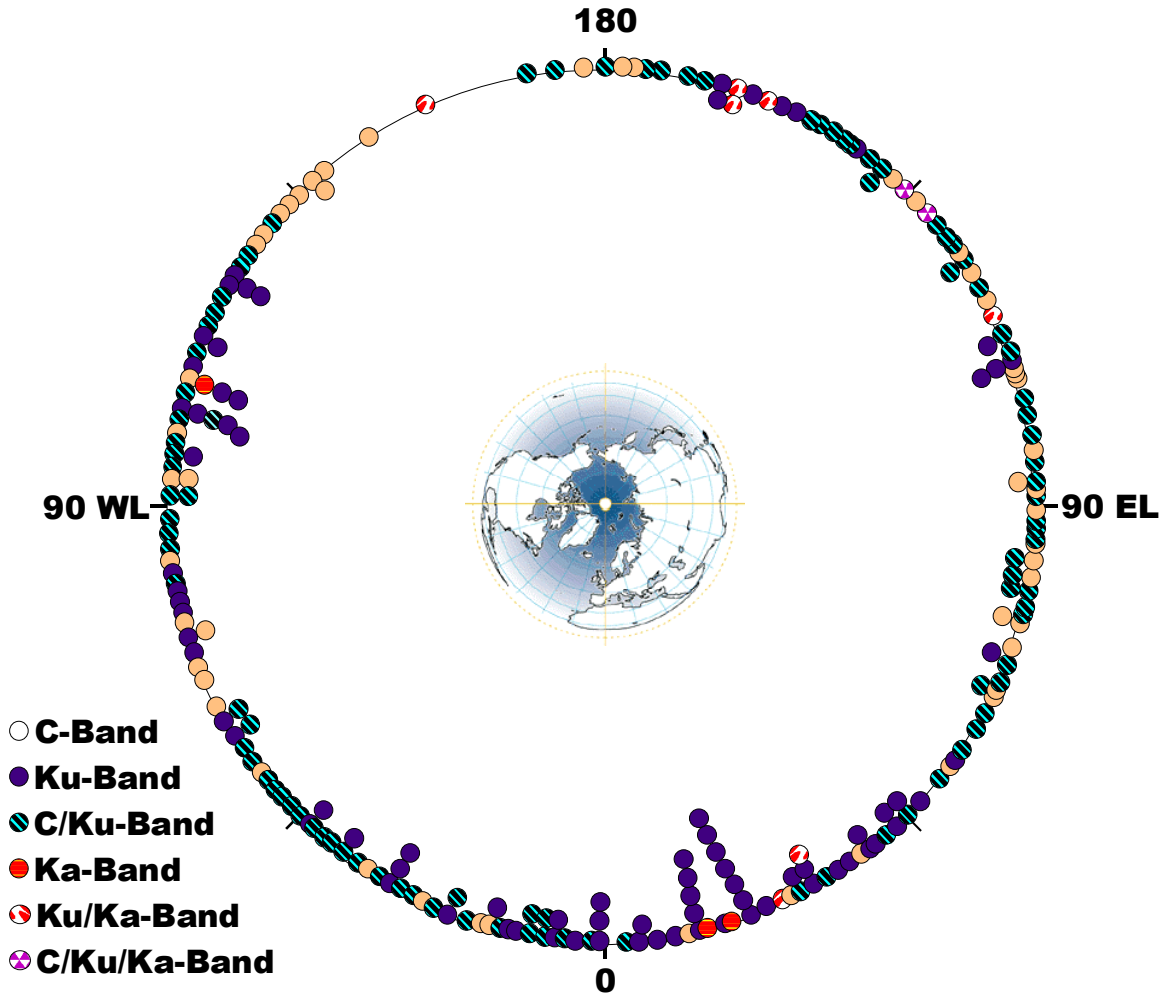

Figure 3.3 Commercial GEO SATCOM Constellation [From Ref 86]

Most communication satellites in use today are geostationary. They orbit the earth directly over the equator, approximately 22,300 miles (35,400 km) up. At this altitude, one complete trip around the earth (relative to the sun) takes 24 hours. Thus, the satellite remains over the same spot on the surface of the earth (GEO) at all times, and stays fixed in the sky (stationary) from any point on the surface from which it can be seen. A single geostationary satellite can see approximately 40 percent of the earth's surface. Three such satellites, spaced at equal intervals (120 angular degrees apart), can provide coverage of the entire civilized world. [Ref 87]

A single transponder on one of these satellites (the part of the satellite that transmits signals back to Earth, of which a typical satellite has 32) is capable of handling approximately 100 million bits of information per second. This means that if the

transponder is accessed for only 90 seconds per day, close to one billion bytes of data (equivalent of 865,000 double-spaced pages) could be transferred. With this immense capacity, today's communication satellites are an ideal medium for transmitting and receiving various types of content, from simple data to the most complex and bandwidth-intensive video and audio content. Figure 3.3 illustrates 235 satellites with 6,356 transponders.

1. Frequency Allocations

The Super High Frequency (SHF) band (3 to 30 GHz) is the most commonly used band of frequencies for broadband applications. Within the SHF spectrum of frequencies there are three main letter designated frequency bands as defined by the Institute of Electrical and Electronics Engineers (IEEE) Standard 521-1984 (1989) as shown in Table 3.1 below:

BAND	UP-LINK (GHz)	DOWN-LINK (GHz)	ISSUES
C	3.7-4.2	5.925-6.425	Interference with ground links.
Ku	11.7-12.2	14.0-14.5	Attenuation due to rain.
Ka	17.7-21.7	27.5-30.5	High equipment cost.

Table 3.1. SHF Satellite Communications Frequencies [From Ref. 88].

The C-band is the most used frequency band. C-band frequencies are also allocated to terrestrial radio relay microwave systems that are used by telephone companies to interlink switching centers. To minimize interference, power flux density limits on satellite transmissions are set and enforced by international agreements. A spot beam antenna, which concentrates energy in a specific location, using C-band frequencies usually covers a large region (i.e. a hemisphere).

Ku-band frequency spot beams are localized to a smaller region (i.e. a continent or country). The Ku-band spectrum came into use as a result of the lack of enough available C-band frequencies to meet growing customer requirements for higher throughput. Because of its smaller wavelength and greater attenuation due to rain atmospheric conditions in this band become a factor. To overcome this effect extra

power margin is design into the link. This not only means that additional power must be available onboard the satellite, but also more sensitive reception systems must be employed to overcome the rain attenuation.

Until recently, Ka-band was used for experimental satellite programs in the U.S., Japan, Italy, and Germany. In the U.S., the NASA Advanced Communications Technology Satellite (ACTS) was used to demonstrate advanced technologies such as onboard processing and scanning spot beams. The growing congestion of the C and Ku bands and the success of the ACTS program increased the interest of satellite system developers in the Ka-band satellite communications network for exponentially growing Internet access applications. [Ref 89]

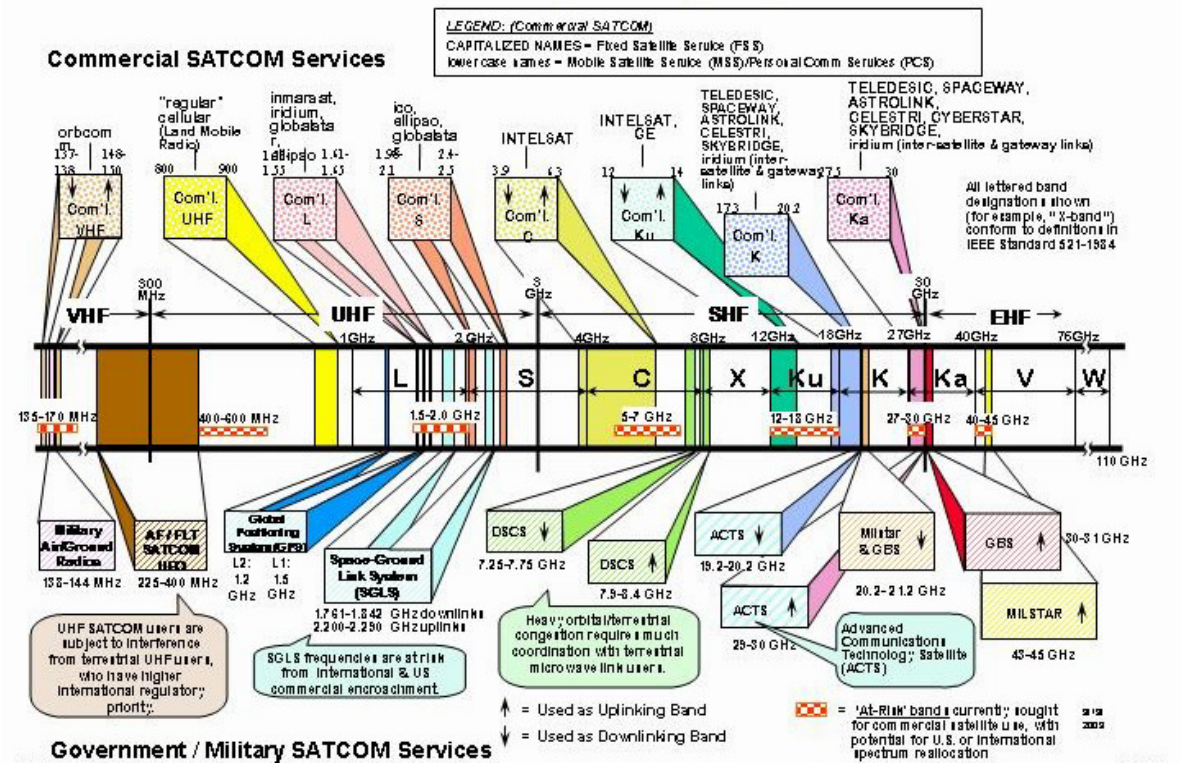

Figure 3.4 SATCOM Frequencies [From Ref 90]

2. VSAT (Very Small Aperture Terminals)

A very small aperture terminal (VSAT) is a device (known as an earth station) that is used to receive satellite transmissions. The very small component of the VSAT acronym refers to the size of the VSAT dish antenna which is typically 3 to 6 feet in

diameter and mounted on a roof, on a wall, or placed on the ground. This antenna, along with the attached low-noise blocker or LNB (which receives satellite signals) and the transmitter (which sends signals) make up the VSAT outdoor unit, one of the two components of a VSAT earth station.

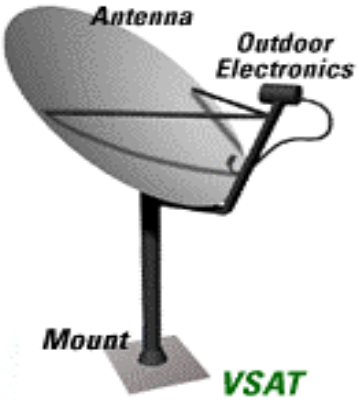

Figure 3.5 VSAT Antenna [From Ref 91]

The second component of VSAT earth station is the indoor unit. The indoor unit is a small desktop box or PC that contains receiver and transmitter boards and an interface to communicate with the user's existing in-house equipment such as local area networks (LANs), servers, PCs, TVs, etc. The indoor unit is connected to the outdoor unit with a pair of cables.

A VSAT network has three components: a central hub (or master earth station), the satellite itself, and a virtually unlimited number of VSAT earth stations in various locations across the country. Content originates at the hub, which features a 15 to 36-foot antenna. The hub controls the network through a network management system (NMS) server, which allows a network operator to monitor and control all components of the network. The NMS operator has the ability to view, modify, and download individual configuration information to the individual VSATs.

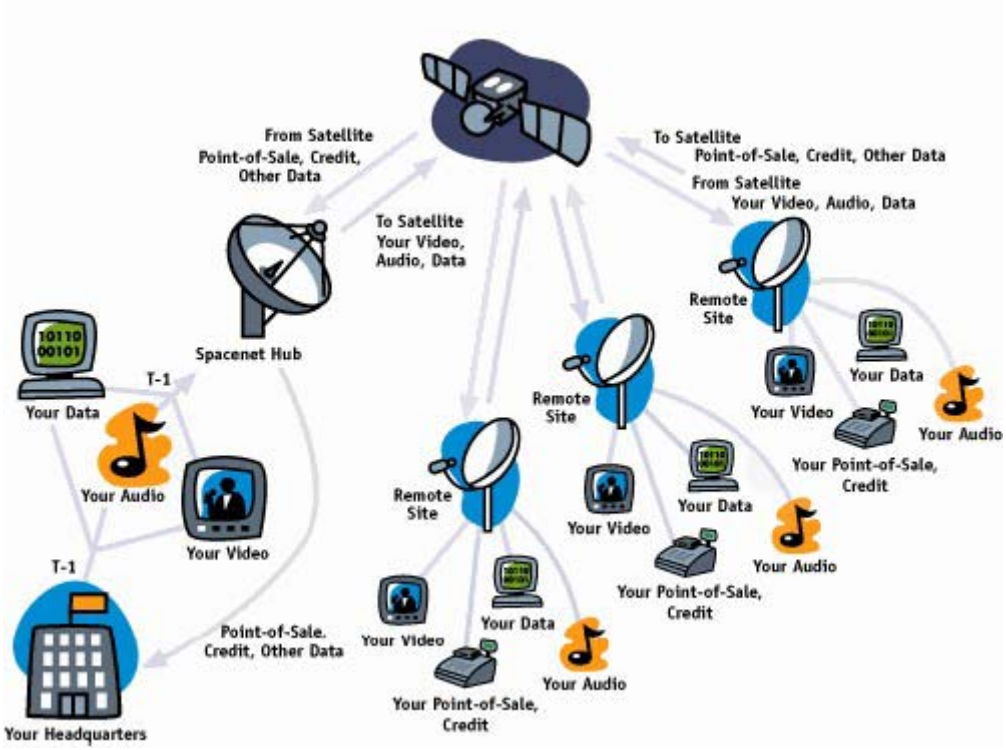

Figure 3.6 VSAT 'Spacenet' Diagram [From Ref 92]

Outbound information (from the hub to the VSATs) is sent up to the communications satellite's transponder, which receives it, amplifies it, and beams it back to earth for reception by the remote VSATs. The VSATs at the remote locations send information inbound (from the VSATs to the hub) via the same satellite transponder to the hub station. This arrangement, where all network communication passes through the network's hub processor, is called a "star" configuration, with the hub station at the center of the star. [Ref 93]

The advantage of a VSAT earth station, versus a typical terrestrial network connection, is that VSATs are not limited by infrastructure. A VSAT earth station can be placed anywhere as long as it has an unobstructed view of the satellite. VSATs provide a viable solution for information sharing during peacekeeping operations in rural and isolated areas.

3. Orbital Altitudes

Satellites are classified by their orbital altitudes with low-earth orbiting (LEO) satellites circling the planet at around 500 to 1000 miles; medium-earth orbiting (also

known as MEO and as intermediate Earth orbit) satellites at about 6200 to 9400 miles; and, as mentioned earlier, geostationary orbiting (GEO) satellites at 22,300 miles. [Ref 94]

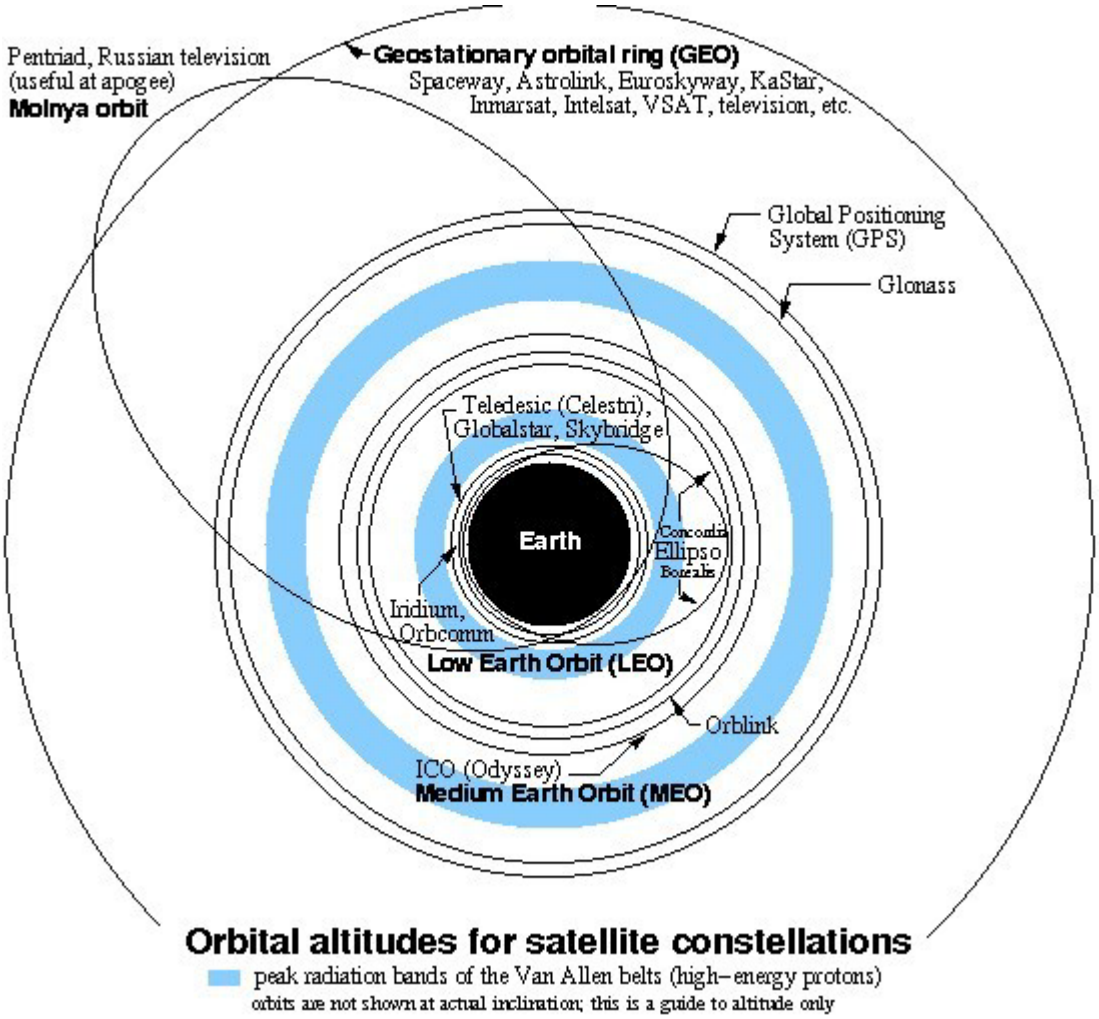

Figure 3.7 Orbital Altitudes For Satellite Constellations [From Ref 95]

LEO satellite constellations act as the cells of a cellular phone system, but instead of the cells staying stationary while the user roams, they are in motion relative to the user as the satellites orbit the earth. The LEOs are designed for both voice and data/fax capability and, because of their low altitude, use low-power, cellular phone sized hand units with omni-directional antennas for two-way communication services. Compared to GEO based systems, LEO-based systems provide a stronger signal that can be picked up by a handheld phone since the transmitter is only a few hundred kilometers away and

require less power from the user terminal to reach the satellite. LEO satellites also minimize perceptible voice delay and allow for the employment of lighter/smaller all-in-one handsets that are flexible, mobile, and appropriate for a variety of telephony services. [Ref 96]

4. Mobile Satellite Service (MSS)

Mobile Satellite Service (MSS) provides a solution to the lack of terrestrial cellular coverage world wide. MSS networks are designed to cover the entire planet. Convergence should become apparent when rival companies and governments adopt the same technology worldwide.

In July 2001, the Federal Communications Committee (FCC) licensed the eight MSS networks illustrated in Table 3.2. All must enter full commercial service by July 16, 2007 with the next milestone coming in July 2003 of having the network architecture finalized and approved by the FCC.

3G Mobile Satellite Service Providers (U.S.)

Company	Satellite type	Coverage	Services	Status
New Iridium (www.iridium.com)	96 LEO	World	Voice and Data	Planned upgrade to existing network
Globalstar (www.globalstar.com)	4 GEO, 64 LEO	World	Voice and Data	Planned upgrade to existing network
Ico Services (www.ico.com)	12 MEO	World	Voice and Data	New network under construction
Celstat America (no site)	1 GEO	Americas	Voice and Data	Planned new network
Mobile Satellite Ventures (www.msat.tmi.ca)	1 GEO	Americas	Voice and Data	Planned new network
Mobile Communications Holdings (www.ellipso.com)	26 MEO	World	Voice and Data	Planned new network
Constellation Communications (no site)	46 LEO	World	Voice and Data	Planned new network
Boeing (www.hsc.com)	16 MEO	World	Aircraft navigation	Planned new network

Table 3.2 FCC licensed MSS Networks [From Ref 97]

With the exception of Boeing, which plans a network dedicated to air traffic control and in-flight entertainment, all hope to offer similar services to those of terrestrial 2.5G and 3G networks: data at around ISDN speeds, along with toll-quality voice, video, and multimedia messaging. Six of the new systems are intended to cover the world using a complex architecture similar to that of existing Iridium (www.iridium.com) which uses a constellation of 66 low-earth orbiting (LEO) satellites operated by Boeing in order to deliver communications services to and from remote areas where terrestrial

communications are not available and that of Globalstar (www.globalstar.com) which consist of a constellation of 48 LEO satellites.

Currently, Iridium provides the backbone network for the Department of Defense's (DoD) Personal Communications System (PCS) called Enhanced Mobile Satellite Services (EMSS). The EMSS program is based on a DoD contract with Iridium which provides 20,000 government users unlimited airtime on Iridium's satellite network. The contract is a service offering through the Defense Information Systems Agency (DISA) for DoD and non-DoD agencies such as the State Department, the FBI, the Drug Enforcement Administration and Joint Staff approved foreign/allied government users. Satellite calls are routed through a DoD-operated gateway in Wahiawa, Hawaii, which provides infrastructure-independent access to the Defense Switched Network (DSN), FTS-2001, Commercial Long Distance, Commercial International Long Distance and the Defense Information System Network (DISN). EMSS service is also known as DoD Iridium service.

A MSS network requires many satellites and an enormous amount of funding. In order for a MSS network to work, the satellites function like mirrors in the sky. Several satellites pick up a call, and this path diversity reduces the possibility of blocked or dropped calls. If buildings or terrain obstruct the phone's line-of-sight to a satellite, a soft hand-off takes place switching the call to an alternate satellite with no interruption. This satellite now continues the transmission of the original signal to one of several terrestrial gateways. Gateways process the calls and distribute them to existing fixed and cellular local networks. Figure 3.8 illustrates how Iridium accomplishes this task. Terrestrial gateways are an important part of MSS providers' strategy to keep technology and equipment easily accessible and integrated with services as closely as possible with existing local telephony networks.

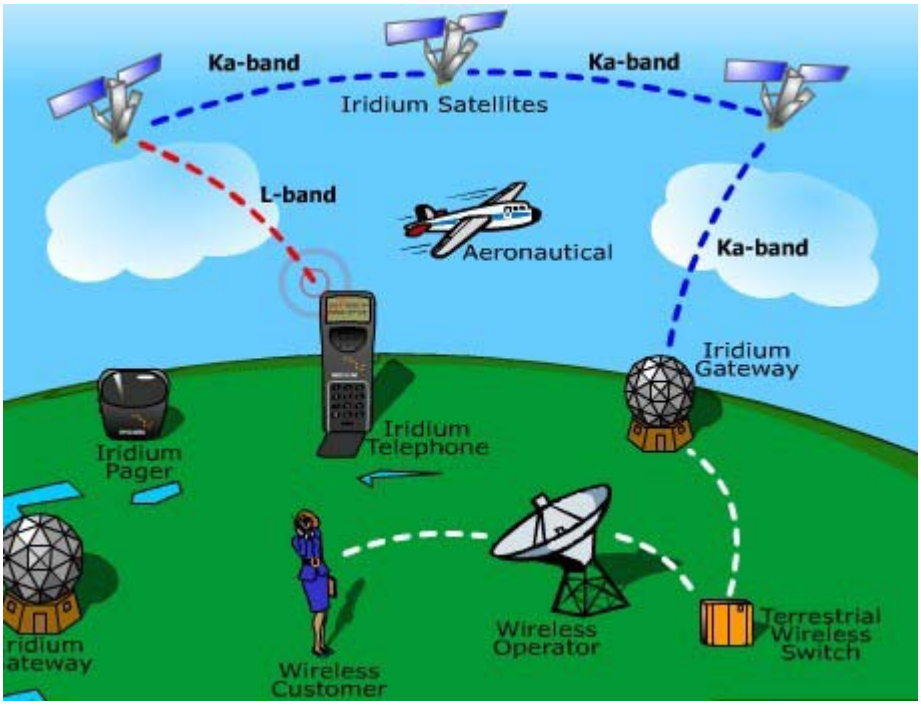

Figure 3.8 How Iridium Works [From Ref 98]

The ITU recommended two sets of frequencies for all countries to allocate to 3G: one for terrestrial and one for MSS. While many national regulators ignored the recommendation for the terrestrial spectrum, almost all followed the one for MSS, making it the only IMT-2000 system that can be used worldwide.

5. Global Mobile Personal Communications by Satellite (GMPCS)

Global Mobile Personal Communications by Satellite (GMPCS) is a personal communication system providing transnational, regional or global coverage from a constellation of satellites accessible with small and easily transportable terminals. Whether the GMPCS satellite systems are geostationary or non-geostationary, fixed or mobile, broadband or narrowband, global or regional, they are capable of providing telecommunication services directly to end users. GMPCS services include two-way voice, fax, messaging, data and broadband multimedia. [Ref 99]

About twenty separate consortia proposed LEO constellations in the 1980s and 1990s, known collectively as GMPCS. These systems differ from MSS in that they use higher frequencies than 3G cell phones, and d not offer the same advanced 3G services. Of the twenty GMPCS constellations, only three have actually been built in LEO orbits.

Iridium and Globalstar both offer voice and narrowband data, at respective speeds of only 1.2Kbits/sec and 9.6Kbits/ sec. Both claim to be faster, but this is using compression, which will not work with applications such as VPNs. Orbcomm (www.orbcomm.com) offers messaging, but with a high latency (up to whole minutes) as users sometimes have to wait for a satellite to come into range. None of these networks have been commercially successful. The builders of all three have at some point filed for Chapter 11 protection. The problem is competition from terrestrial cellular networks, which already reach nearly every lucrative market. Other would-be GMPCS providers have cut back their plans. Bill Gates's Teledesic claimed that it would have an 840-satellite system operational by now. Instead, it has repeatedly scaled back its plans, first to 288 and now to only 30. Teledesic has also been delayed, now promising global coverage by 2005, and emphasizing fixed services, rather than mobile services. The ITU is requiring Teledesic to launch at least one satellite and sign up customers by September 2004, or lose its spectrum. [Ref 100]

Delays and financial problems also affect the new MSS licensees. Ico Services (www.ico.com) is the only one which has launched a satellite despite going through bankruptcy. Ico and Iridium emerged successfully from bankruptcy and both continue to launch new satellites. Iridium plans to upgrade its network to MSS capability. Globalstar plans to do the same, but not by using LEOs. Technology advances have made it possible to build “super GEO” satellites, so powerful that a device a little larger than a cell phone can pick up the signal.

Three other companies are already providing GMPCS services via GEO satellites, though none offers a cell phone that will work in the United States. Thuraya (www.thuraya.com) offers voice and 9.6Kbit/sec data throughout the Middle East, Africa and Europe. Asia Cellular Satellite (ACeS, www.acesinternational.com) serves Asia, with an ambitious goal to bring telephony and 2.4Kbit/sec data to 50,000 rural villages within a year. A single GEO satellite is cheaper than a LEO constellation making the service more affordable. Both Thuraya and ACeS are based on Global System for Mobile Communications (GSM), making dual-mode phones easier to manufacturer, though they don't provide all the advanced features GSM users enjoy. The Short

Message Service (SMS), for example, only works when connected to a terrestrial network.

Figure 3.9 ACeS Equipment in Use [From Ref 101]

Inmarsat (www.inmarsat.com) covers most of the world, at data rates up to 64Kbits/sec. Unfortunately, the terminals for such speeds are larger than a cell phone and closer to a laptop. They are described as portable rather than mobile. War reporters in Afghanistan performed correspondence for CNN and BBC using the Inmarsat network. The appearance of correspondence using a videophone was made possible by using a video camera connected to a ground unit. The setup uses powerful compression since the briefcase-sized units only have a throughput of 64Kbits/sec, one-sixth the capacity of a traditional ISDN videoconferencing system. The setup saves on bandwidth by transmitting only the parts of an image which change between frames, so presenters sending live video stood still. The less movement broadcasted, the more detail seen by the viewer. [Ref 102] The system was originally developed for maritime use. Ships were fitted with a large dish that had to remain pointed at a specific point in the sky as the ship moved. Modern terminals can be fitted to smaller and more maneuverable vehicles through non-directional antennas with no moving parts. Inmarsat has plans to launch more powerful satellites aimed at the portable market in hopes of reducing the terminal size and boosting throughput to 432Kbits/sec.

Some MSS providers have already or planned to file an application for an ancillary terrestrial component: a series of base stations in major cities that would provide

a much stronger signal than that from the satellites enabling MSS phones to work inside, as well as in canyon streets where buildings block a phone's view of a satellite. ACeS and Inmarsat employ this technique in remote areas of Africa, using base stations mounted on trucks to roll out cellular networks where no infrastructure exists. [Ref 103]

G. WIRELESS IN REMOTE VILLAGES

When disaster strikes in an unsuspecting part of the world and wipes out previous infrastructure, communication becomes difficult. Work being performed by an American NGO called the Jhai Foundation may be a solution to this type of situation. Jhai is managing a project called the Remote IT Village Initiative. The project is aimed at establishing the means to communicate and use simple business tools in five remote villages in Laos which is one of the most bombed areas of the world. All of the villages lack electricity and phones and experience torrential rains followed by high temperatures and red dust. Each village will have a Jhai computer connected in a network with the other villages that connects to the Internet and to their high school-based Internet Learning Centres (ILC). The computers can also be used to write documents and create spreadsheets.

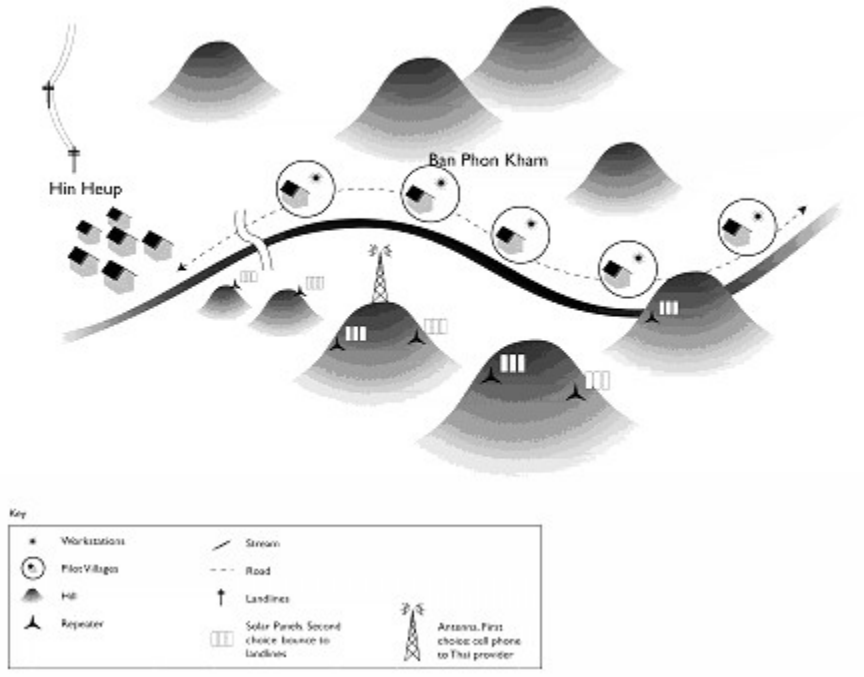

Figure 3.10 Schematic for Remote IT Village Project [From Ref 104]

The Jhai PC was designed by a team led by one of the leading design engineers in the world, Lee Felsenstein. The PC is built of embedded circuit boards that are rugged and devoid of moving parts such as fans or disc drives and are fit together in a compact stack without a case nor power supply. It is made to operate for long periods of time without service or attention and along with the printer, can survive dirt, heat, and immersion in water. [Ref 105]

Figure 3.11 Jhai PC Prototype [From Ref 106]

The equipment will be powered by electricity stored in a car battery charged by foot cranks which are essentially bicycle wheels and pedals hooked to a small generator. The generator is connected to a car battery and the car battery is connected to the computer. Connection with each computer to the others will be by radio local area network (LAN). Each village will connect to one repeater station powered by a solar means on the ridge near the river valley. That station will then send the radio signal to the microwave tower nearby and eventually to a server in Vientiane that will connect the villages to the Internet. [Ref 107] This project will pave the way for bringing technology to devastated areas during CHEs and peacekeeping operations.

H. WIRELESS DEVICES

There is a large number of wireless devices such as satellite phones and personal digital assistants (PDAs) used for many applications. The number and variety of such devices keeps growing at a rapid pace as new processing, display, battery and wireless technologies are invented and as new applications for these devices are envisioned.

Figure 3.12 Phone/Digital Camera Combos [From: Ref 108]

Starting on the left, the phones pictured in Figure 3.12 are Sanyo's 5300, Nokia's 3650, and Motorola's T270i. In addition to being able to email pictures, all three phones come with features such as voice-activated dialing, one-touch access to voice mail, and phone books that store hundreds of contacts.

Figure 3.13 HP Compaq iPaq PDA [From: Ref 109]

The PDA illustrated in Figure 3.13 can be used to store information downloaded from a laptop. PDAs operate using one of several operating systems (OS). Windows is a popular OS as seen above. This device packages many functions of a PC such as calendar, contacts, spreadsheet, and word processing and presents them in a handheld.

Figure 3.14 Tacter R-PDA [From Ref 110]

The Tacter Rugged-PDA provides situational awareness and communications capabilities to the soldier. This PDA has a unique modular design which enables an operator to reconfigure the R-PDA hardware and software for a specific mission without changing the basic unit.

Figure 3.15 Motorola Iridium Phone [From Ref 111]

The Motorola Iridium Phone uses satellite communication and can be used globally. When connected to a laptop, this phone can provide Internet access in remote and rural areas.

Figure 3.16 2200T Secure Tactical and Communicator System [From Ref 112]

Action Systems 2200T allows the user to perform secure communications anywhere. The system includes an integrated laptop, a satellite phone, and a Sectera encryption device. Some of the systems features are teleconferencing, voice, and data Communications with encryption. It comes packaged in a shock resistant, environmentally sealed, rugged airline carry-on sized case. The system operates on a wide range of AC or DC power.

I. SUMMARY

The benefits realized through the use of wireless for information sharing are tremendous. An increase in mission efficiency, due to convergence among various activities in the field, alleviates many of the issues that have plagued the UN and NGOs in the past. All agencies can communicate using standard equipment while maintaining a common infrastructure. Wireless technology has paved the way for real-time collaborative planning and coordination. The reliable dissemination of information to the area of concern is paramount.

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IV. WIRELESS SECURITY

A. OVERVIEW

This chapter discusses information assurance for wireless communications.

B. INTRODUCTION

Wireless communications can present an incredible opportunity for bridging the gap in the sharing of information among UN agencies and international actors, but it can also be susceptible to security vulnerabilities. Relief actors all over the world depend on reliable and timely information used for making decisions at the headquarters as well as in the field. The degree of information accuracy depends on the level of security in place. Certain areas of the world present a hostile environment and warrant more safeguarding of information than others, but nevertheless, data integrity must be maintained. MSS information assurance will be the focus of this chapter.

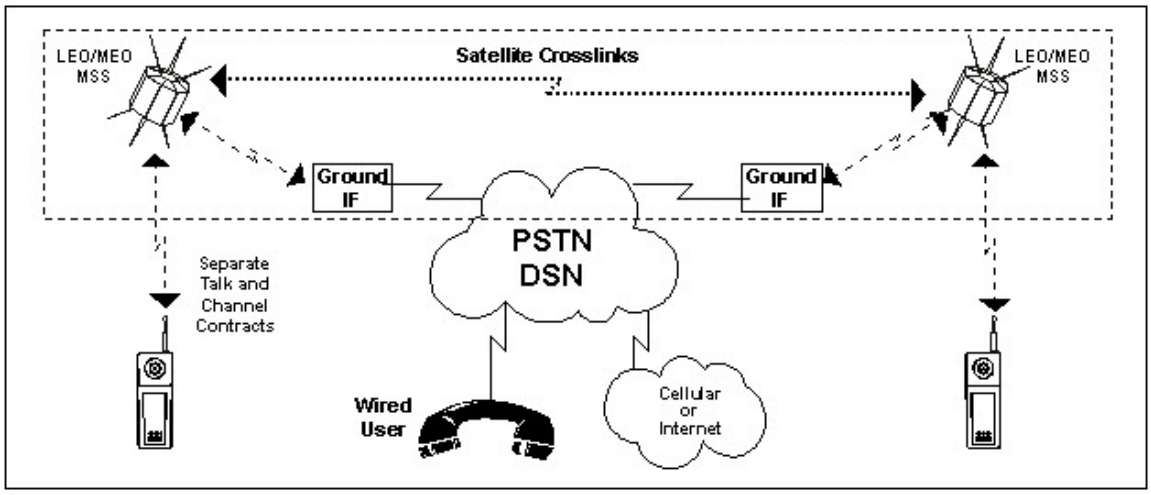

Figure 4.1 Mobile Satellite Subscriber Environment [From Ref 113]

Figure 4.1 illustrates a user making or receiving a phone call from a portable mobile user instrument to another portable instrument, to a wired telecommunications user, or to a cellular telephone. The elements of the above illustration can be broken into three sections: the user environment, the service provider network, and the public network. The user environment consists of the hand-held phone and associated user, as well as the talk and control channels. The service provider network infrastructure

includes the equipment and connections from the satellites and earth stations, the satellite control infrastructure, and the ground entry points that interface with the Public Switched Telephone Network (PSTN). The public network includes connections to wired users, the Internet, and other mobile network providers.

In this thesis, wireless defines a set of commercially developed systems and products, and a system infrastructure, that transfers personal communications from wired to RF transmission environments. Since MSS is commercially based, it was not initially built to specifications for military applications. In recent years, the military has increased its use of such systems. It is important that security measures for new wireless systems be developed in conjunction with the equipment manufacturers and service providers involved in the wireless industry.

C. REQUIREMENTS

Non-military organizations face some of the same information assurance issues and requirements that military organizations face. The requirements most important to non-military organizations are interoperability among response elements and protection from interception of communications traffic that is normally unclassified but may be sensitive, denial of service, and network intrusion.

1. Functional

The functional requirements of a MSS are user and recipient identification and authentication (IA), voice and data confidentiality and data integrity, data transmission capabilities of 19.6 Kbps for email and other short message services, interconnection to PSTN, cellular networks, and data networks, cross-connected satellite constellation for primary call handling, and global paging services via LEO satellite networks.

2. Interoperability

In order for military, UN and other civilian agencies to buy off on the use of MSS the system must interface with all PSTN systems worldwide, user instruments used with the MSS system can be used with cellular telephone systems, and the digital voice quality should be sufficient enough to traverse the PSTN and be intelligible in cellular systems.

3. Anticipated

Future requirements for MSS include increased bandwidth for data transfer, increased voice quality for conferencing, reduced cost of user instrument, and support for security management infrastructure (SMI).

D. POTENTIAL ATTACKS

Wireless service providers' concern about the confidentiality of the information transmitted and received by a user's wireless phone is usually secondary to their concern about theft of service and denial of service. Commercial service providers want to ensure that the system prevents unauthorized use of the service by a nonpaying customer and that the service is functional for paying customers. As a user, military and non-military organizations are more concerned with the protection of the transmitted information. [Ref 114]

1. Passive

Passive attacks include such tactics as eavesdropping, traffic analysis via dialed phone numbers and caller ID, and spoofing in which the attacker intercepts data, splices in information, and retransmits the message as the originator of the message. Interception of data from a satellite downlink transmission can be accomplished from anywhere in the satellite footprint which could be hundreds of miles.

2. Active

Active attacks are aimed at either the voice/information channel or the control channel. Interception of control channel information is a larger threat to service providers, while users are typically more concerned with the confidentiality of the information channel. Denial of service by electronic jamming or altering control channel data can be a threat to users and providers because of the vulnerability of control channel information when it is transmitted over the air.

3. Other

Theft of portable wireless user devices containing sensitive information and user programs is also a security concern. The increasing integration of processing and communications elements in mobile systems can make the theft of user equipment very destructive because of the storage volume and aggregation of information contained within that equipment.

E. COUNTERMEASURES

Sufficient countermeasures must be implemented in order to provide privacy, authentication, and message integrity in accordance with the level of information being transmitted. Type 1 security, primarily for the military community, requires countermeasures that provide the maximum possible security for message traffic. Sensitive information requiring Type 2/3 security requires less stringent countermeasures. In order to maintain a secure infrastructure, the agency must overlay a supporting system infrastructure to incorporate authentication and key management and other countermeasures for each level of information as appropriate. Creating some type of SMI incorporating key management and other countermeasures in a MSS must fit into a global management structure. [Ref 115]

1. Encryption

The primary security requirement for cellular phones, as with any RF transmission system, is protection of user information over the air. There are two primary modes for protection. The first is encryption to secure the information and transmission security (e.g., signal spreading or hopping) to protect the channel and possibly to provide protection against signal detection. Information on the control channel is also user related at times in that it provides information on location, privileges, called party, and calling party. Such information is useful for traffic analysis. A second important requirement for users is IA of the parties in a communications session.

Encryption algorithms can be embedded or implemented on the same tokens that provide user identification and privileges. Inband signaling is also a target for encryption to prevent traffic analysis. For instance, encryption of dialing and data digit signals sent over the RF network must be considered, as well as caller ID information that precedes a received communication.

2. Identification and Authentication (IA)

Some sort of token or smart card with the telephone handsets can also be integrated into the satellite network. Cellular systems use Subscriber Identity Module (SIM) cards to provide countermeasures to enable user and user terminal authentication (and security management). If a phone is stolen, for example, the user can notify the service provider, who then deactivates the SIM card in the stolen phone. The phone can

even be programmed to flash "Stolen Handset" to notify the thief that the handset is useless. The same measures that providers use to prevent theft of service from the provider can be adapted to provide IA security services. For increased security, service providers can permit user groups to control access of their own individual members using software tools that the service providers use to provision systems. The same provisioning capabilities can be expanded to include information such as security clearances, access to keying and other SMI services, and restriction of services within the limits of the overall provisioned service.

3. Availability and Integrity

The availability and integrity of communications are largely a function of the protocols used by the service provider to connect calls, to provide reliable communications channels, and to service an optimal number of customers. As with any telephone system, busy channels are possible, although a busy system (rather than called party busy) is much more likely in cellular systems depending on the number of subscribers within a given cell or coverage area. To maximize the number of users in a given area, the RF power output is often controlled for provider and/or user equipment on a dynamic basis to within a tolerable channel error rate for digital voice communications. Error correction codes are then used to correct the errors that would not be tolerable for data communications. To enhance both availability and integrity, a caller priority technique could be implemented to eliminate busy connections for critical calls and to reduce the number of concurrent general user calls processed within a given area in support of emergency operations.

F. TECHNOLOGY ASSESSMENT

Service has been initiated on the Iridium and the Globalstar networks. Proposed technologies include dual-mode (GSM/MSS) handsets, voice and data transmission, paging, facsimile, and position location. Iridium will use a combination of Frequency Division Multiple Access (FDMA) and TDMA multiple access technologies, while Globalstar uses CDMA.

The National Security Agency (NSA) has certified Motorola's Type 1 Iridium Security Module (ISM) for the Motorola Satellite Series 9505 portable telephone. The ISM is intended for the protection of voice communications at security levels up to and

including Top Secret. The module is the first Type 1 certified security product using Motorola's revolutionary new sCore architecture which employs a single, commercial digital signal processor (DSP) supported by commercial programmable logic. With this small attachment, authorized users who subscribe to satellite voice service are able to digitally encrypt their sensitive voice conversations. The military currently uses this technology.

Figure 4.2 Iridium Security Module [From Ref 116]

1. Desired Security Solution

Ideally, a MSS telecommunications network will provide confidentiality for both talk channel and control channel information. Military as well as non-military users require reliable service with some assurance of data integrity and confidentiality, as well as protection from spoofing and misidentification. Integration of the smart card technology used in GSM phones with the satellite phone handsets could help provide adequate protection for users.

2. Best Commercially Available Security Solution

Currently, the best commercially available security solution lies in Iridium and Globalstar networks' use of commercial-grade encryption over the air link. The only

NSA Type 1 solution today is the ISM. The ISM provides handset-to-handset encryption and handset-to-STU/3 encryption through a red gateway for military uses. The primary security needs for satellite telephone services are end-to-end confidentiality for user information and the protection of caller and calling party identification.

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IV. CONCLUSION

A. SUMMARY

As long as seething ethnic, political, religious and natural disasters are global realities, the UN will continue to play a major role in protecting the innocent, promoting and maintaining peace. However, as the leading international organization mandated to resolving conflicts and humanitarian suffering around the globe, the UN simply lacks the resources and personnel to deal with the vexing complexities posed by most CHEs and peacekeeping operations. The challenges posed by these missions are obviously too overwhelming for the UN to shoulder alone. A more representative international community must collectively share in the burdens of peacekeeping operations. However, in order for such an alliance to be effective, the UN and partner agencies must resolve their longstanding communication problems, which include, inadequate equipment, non-compatible equipment, and non-standardized infrastructure. The UN and the military must find a way to integrate their communication systems with the thousands of NGOs, IOs, and other humanitarian agencies information systems. At present, each agency operates in isolation, most have technology platforms with databases and applications that are incompatible with other agencies. Moreover, most of theses agencies as a whole do not have the technology infrastructure to handle integration.

B. SOLUTION

What is needed is a comprehensive wireless IT strategy that can provide cross-functional communication throughout the many organizations involved in CHEs and peacekeeping operations, especially at the field level. This wireless IT infrastructure should be based on a number of prerequisites to include, an agency's desire to communicate clearly, a shared interest in achieving common understanding among those communicating with one another, and organizational arrangements that facilitate message transmittal to the lowest levels. These prerequisites are especially important because during a CHE or peacekeeping operation many diverse groups of humanitarian organizations operate in the same environment without knowing or sharing the same definitions of terms or have the same understandings and assumptions underlying the information transmitted.

The UN needs to be more aggressive and committed to building a modern wireless IT enterprise that can aid in shortening the communication distance and clearing up the ambiguity among decentralized and often isolated humanitarian agencies operating in the field. The UN has spent decades establishing processes and procedures on how to conduct peacekeeping operations. Now they need to shift to a brand new paradigm, one that involves investing in a variety of wireless communication technologies that can provide the seamless exchange of information and intelligence needed during CHEs and peacekeeping operations.

The sheer magnitude of some of these missions along with contextual issues such as geographical locations and severity of the conflicts requires funding for wireless IT. The UN's and NGOs fiscal crisis are well documented and the drastic increase in the cost of CHEs and peacekeeping operations combined with the unwillingness on the part of many member states to take care of their financial responsibilities only exacerbates the problem. However, the UN must find a way to implement measures that would ensure sufficient funding is provided for the acquisition and use of wireless IT to include, hardware, software, security, scalability, reliability, integration of process and a sound technical infrastructure. Moreover, its cost must include skilled personnel and the time that must be devoted to its acquisition, organization, and presentation. Acquisition costs may initially be expensive. However, the greatest value of well-designed wireless communication architecture with a secure and reliable storage and retrieval system along with an on-line data services is the enormous saving in resources, such as time and money. A well conceived wireless information platform would make it easier and more cost effective to obtain larger quantities of data compared to the investment necessary to gather the same amount of information by other methods. Although not examined in this study, the authors propose that the long-term benefits outweigh the high short-term cost of investing in a properly constructed wireless IT foundation.

Furthermore, a well-planned and integrated wireless communication structure in addition to improving the exchange of two-way information flow would also help improve coordination and decision-making. In an organization as large and complex as the UN, if there is to be any chance of consistency among the actors, the UN must achieve a minimally adequate degree of coordination with its multiple partners who also

take part in CHEs and peacekeeping operations. A well chosen wireless communication medium would be the ideal tool for bringing together and integrating the activities of the different humanitarian entities, whether separate agencies within the UN hierarchy, agencies of different governments or governments themselves, or relief elements from the public or private sector.

The same holds true for decision-making. A key element of decision-making is the time factor. Time constraints especially during a CHE or peacekeeping operations can profoundly affect the ability of decision makers to gather and analyze information coming from different sources, and to project the consequences of different alternatives. Decision makers both at the field and at headquarter level need quality and sufficient information to serve as a basis for making reasoned choices during CHEs before making any final decisions as to which course of action to take. A well thought out wireless IT platform, would be able to provide decision makers total access to secure and verifiable data that explored various alternatives under considerations, including comprehensive projections of all possible consequences resulting from each proposed course of action during a CHE.

The world is still a place in conflict and constant flux. Ongoing ethnic strife is a painful reminder that the world is still a precarious place. Disease and famine caused by natural disasters, and in some cases by man himself, further illustrates how tenuous life can be. These challenging issues have no short-term solutions. They will not go away any time soon, and as a result, will keep the UN, military, NGOs, IOs, etc., actively engaged in operations designed to prevent and hopefully control such calamities before they develop into all out catastrophes. However, in order for the UN to carry out its mandate of global peace, security, and humanitarian aid, it will need a common wireless IT management foundation and investment strategy. Without this foundation in place, progress in CHEs and peacekeeping operations will be fragmented at best and limited in their overall effectiveness.

C. LIMITATIONS OF THESIS

It is also important to note that the rapid innovations and dynamic changes in the wireless industry may render topics in this research obsolete in following years to come. The speed of change in this field, especially concerning policy and standards, and rapid

interactions among all the elements in a wireless system, are complex and constantly evolving. Thus, developing any wireless system in the future should consider these constraints carefully.

D. FOLLOW ON RESEARCH

Research in the wireless technology/telecommunication industry continues at a rapid pace. Areas that were not addressed in this research provide topics of future study:

- Intelligent Vehicle Transport System (IVTS). Two main wireless schemes in IVTS have emerged: one is vehicle-to-vehicle link also known as IVC (inter-vehicle communication) and other roadside-vehicle-roadside link. Both these links serve complementary roles. Whereas vehicle-to-vehicle link is necessary to safety reasons towards accidents whereas roadside-to-vehicle link is necessary for broadcasting information useful to the drivers of the vehicle. This may be useful in when communicating with vehicles in nearby areas.
- Geographic Information Systems (GIS). Unlike with a paper map, where what is shown is what is seen, a GIS map can combine many layers of information through the use of mapping software that links information about where things are with information about what things are like. The difference is that this information comes from a database and is shown only if the user chooses to show it. The database stores where a point is located, how long the road is, and even how many square miles a lake occupies.

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